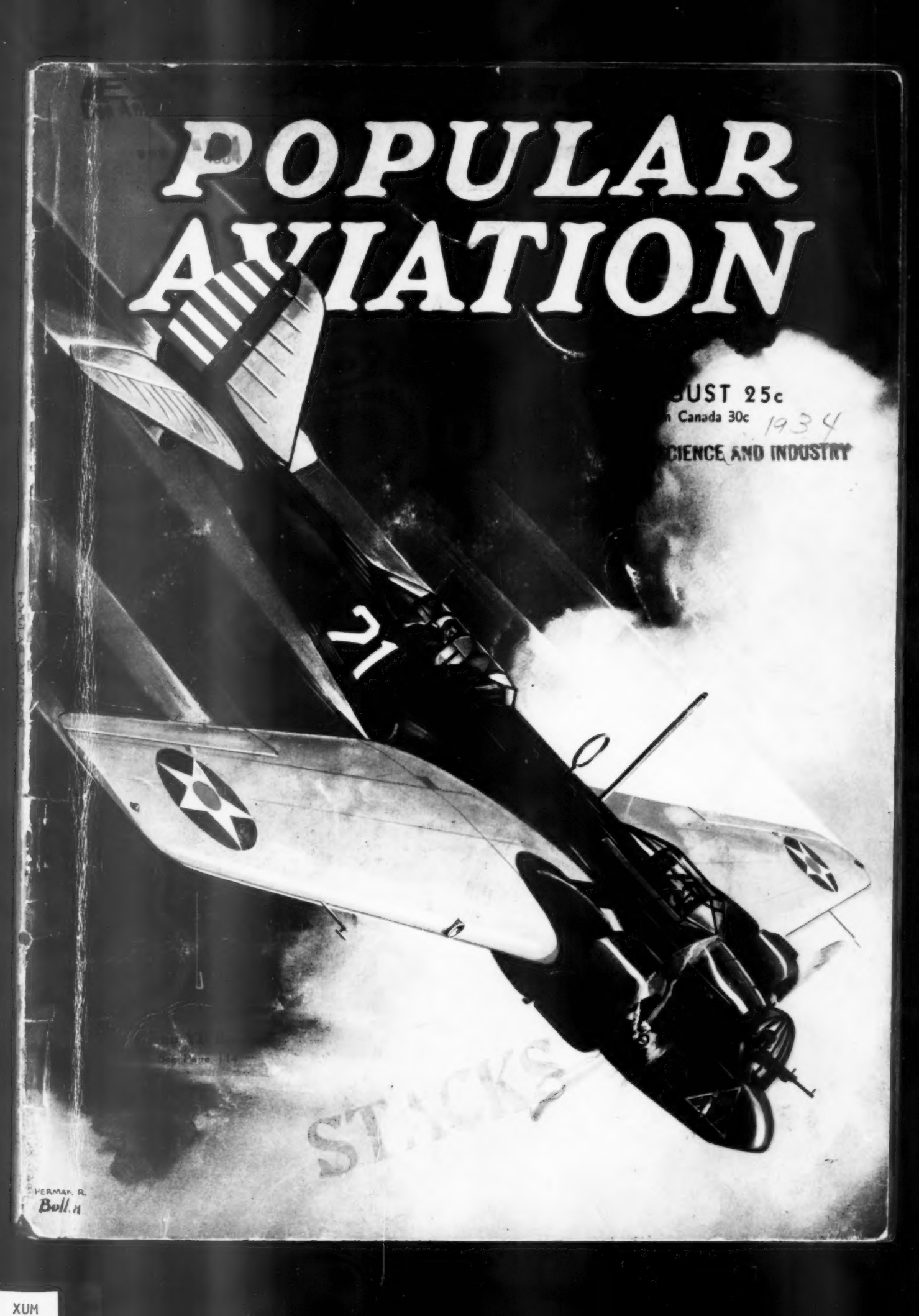
POPULAR AVIATION



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CIENCE AND INDUSTRY

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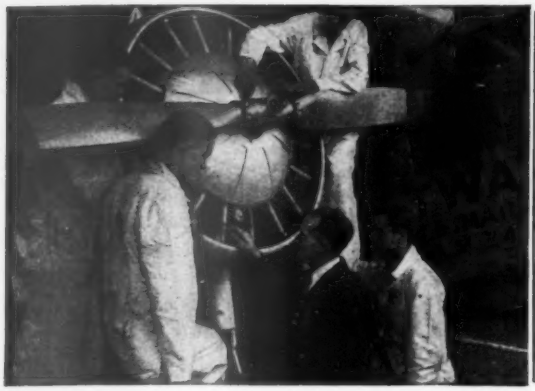

Earl Elleman, John Gaiser, John Maas, and Alfred Jordan . . . four of many Parks graduates employed by TWA.

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Above—The Dormitory entrance.

Right—The Administration building, which houses the offices of the College.

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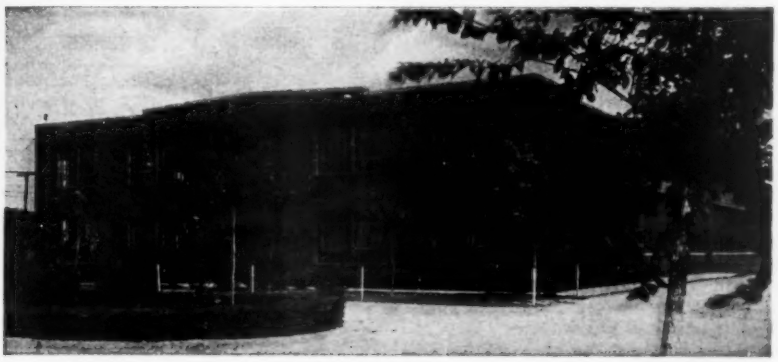

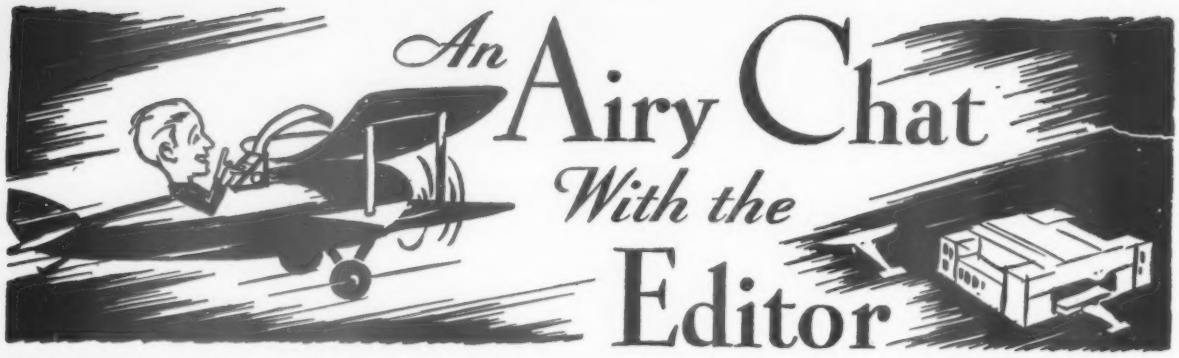

An Airy Chat With the Editor

IT'S funny how things apparently run in cycles. Everyone in aviation seems to break down with parallel ideas all at one time. And now it's bird-soaring that has come to the fore during the past few months among our technical men.

Among the foremost of the Bird Study League are our engineers, Larry Lesh, Raoul Hoffman and J. D. Van Vliet. All of them will tell you that they have been working along these lines for years, as they undoubtedly have been doing, but just the same they all burst in on P.A. within a few months. And a whole lot of good is going to come out of this latest trend—mark my word.

* * *

'WAY BACK, the earliest of the investigators studied birds—and very naturally. Then, after the first stiff-wing plane of the Wrights flew, the minds of men went into a more definite channel and were largely content with rigid wing investigations. And interest in bird-flight lapsed for the time being.

But now, understanding the limitations of the rigid wing, our technical men are back with the birds again—particularly soaring birds. They know enough of the elements of aerodynamics to understand that full advantage is not being taken of the air by rigid wings and that the birds are really the master flyers after all. We are burning up too much gasoline with the present rigid wing planes and there are a lot of other difficulties that will be solved when we can do as well as the birds.

* * *

MANY LETTERS were received from our readers, congratulating Mr. Brown on his articles dealing with our army and navy planes. But, among the deluge of letters were a great many writers who steadfastly refused to believe that our military planes were not the best on earth. They even accused us of printing foreign propaganda when they looked over the tables.

But it is our idea that true patriotism consists in acknowledging our shortcomings and inferiorities—and correcting them before they prove a menace to our safety and well-being. Anyone who has followed the story of Army's failure as an airmail carrier in the daily papers can hardly contend that we have a supreme air-service. And we, as taxpayers and citizens, have a perfect right to raise a howl when politics defeats the purpose for which our army and navy was intended.

Ever since George Washington roared in protest against certain acts of the Continental Congress, we have been getting the same sort of deal. There is nothing at all new in the situation except that Washington cried for horses, ammunition and clothes while we are crying for better airplanes and a more effective national defense.

* * *

WE only wish that the Department of Commerce would grease the rails for amateur aviation, and make it possible for amateurs to fly before more time is taken up with the $700 airplane project. Even though the $700 plane should come into being, hardly anyone could fly it under existing laws. Until we are given as much freedom in flying a plane as we are in driving an automobile, all attempts at the popularization of private flying will fail.

* * *

WITHOUT delving into statistics, I'm willing to bet that at least 1,000 satisfactory lightplanes have been designed and flown. So why take up the development of another lightplane under the auspices of the government? If the Department of Commerce only had some oldtime hardboiled lightplane fans on their committee, who have designed, built and flown lightplanes for years, then we might expect to get somewhere, but no real progress can be expected from a committee of "big-scale men." The construction of a lightplane differs greatly from a large ship and an amateur builder fully realizes this.

We suggest, respectfully, that in place of Amelia Earhart and several academic persons now on the $700 committee, that they substitute lightplane experts such as O. G. Corben, B. H. Pietenpol, Leslie Long and many others of the lightplane fraternity who have actually built well performing planes—not theoretically but actually.

* * *

THIS REMINDS me that we are beginning a new series of lightplane construction articles by Manley Mills. In this series he shows the details of the well-known Epps biplane, Ford powered, that has proved very successful.

* * *

IT DOES an author's heart good to hear the laments of a great many readers when his series of articles is temporarily interrupted, and my thanks go out to the many readers that protested against the omission of the "Practical Lessons in Aviation." I fully appreciate your letters of praise, I am sure.

But to be honest and frank with you, I'll tell you why this omission happened. The weather has been terribly hot in Chicago and the author has perspired over this job until he passed it up for the time being. As soon as it cools down, old dears, we will resume the burden of our story. Thank you!

* * *

AND now I wish to introduce a new feature to you fellows who are actively engaged in flying and barnstorming. This is the new "Kontact Klub Kolumn" which has been in demand for some time but which has been postponed for various reasons until this issue.

If you wish to contact or locate anyone in the flying game, just send in your notice and it will be printed free of charge. Pilots, mechanics and others wander about the country—it's the nature of the job—and very often their friends are unable to locate them without a service of this kind.

This feature is the outgrowth of the "Port Of Missing Men" which has appeared from time to time. So avail yourself of this privilege and page as many people as you wish. Remember—this is your headquarters.

* * *

OUR technically inclined readers will take a great deal of pleasure in the article on sound-proofing by Dr. Alexander Klemin appearing in this issue. Very little has been printed on this important subject up to the present time and, being quite out of the trend of aeronautics, sound-proofing has therefore been more or less of a mystery to the aviation industry.

Prof. Klemin, as you probably know, is an outstanding authority on the sub-

(*Concluded on page* 133)

POPULAR AVIATION

Including SOUTHERN AVIATION and AERONAUTICS

A MAGAZINE FOR THE PROMOTION OF AMATEUR AVIATION AND PRIVATE FLYING

Volume XV AUGUST, 1934 Number 2

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POPULAR AVIATION, Volume 15, Number 2, August, 1934. Published monthly by Aeronautical Publications, Inc., at 608 South Dearborn Street, Chicago, U. S. A. William B. Ziff, Publisher; B. G. Davis, Editor; John B. Rathbun, Managing Editor. New York Office, 551 Fifth Avenue, New York City. Subscription $2.50 per year, single copies, 25 cents, foreign postage, $1.00 per year extra. Contributors are especially advised to retain copy of their contributions, which must be accompanied by return postage. All such material will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Any copy accepted is subject to revision or changes to meet the requirements of this publication. Payment for copy used will be made at our current rates. Entered as second-class matter, January 24, 1933, at the Post Office, Chicago, Ill., under the act of March 3, 1879.

The Vultee V-1A Transport is a

by

E. STANTON BROWN

Commercial Airway Editor of

POPULAR AVIATION

Three-quarter rear view of the Vultee low-wing monoplane showing the deep skirt between the wing and body. This undoubtedly improves the performance.

A SLEEK new ship, its metal surface glinting in the sunlight, stood poised on the runway at the Grand Central Air Terminal at Glendale, California.

The single 735 h.p. Wright "Cyclone" engine in the nose suddenly ceased its staccato idling chatter and broke into a full-throated roar. The tail came up and the ship darted down the runway and soared gracefully and proudly into the air.

By the time it had reached the boundary of the field, the landing-gear had disappeared completely into the wing, leaving a smooth flush bottom surface, while the tail wheel had been partially retracted into the tail.

The Vultee V-1A, the world's newest and swiftest transport plane was in the air. Designed as a super-high speed transport, it has a high speed of 235 m.p.h. and cruises at 215 m.p h. at 10,000 ft., using but 75 percent. of its power. Briefly, the Vultee Model V-1A Transport is an all-metal, 10 place (2 pilots), low-wing cantilever monoplane with split trailing-edge wing-flaps. Fully loaded with eight passengers and 340 lbs. of baggage and mail, it has a range of 1,000 miles.

The ship was designed and built for the Airplane Development Corporation by Gerard F. Vultee, one of the youngest and best known aeronautical engineers in the United States today. Mr. Vultee, previously with the Lockheed Aircraft Corp., designed the "Sirius" for Colonel Lindbergh, which had the first commercial retractable landing gear to be put into production. He designed the Lockheed "Air Express," which was equipped with the first N.A.C.A. cowling, for Commander Frank Hawks; Harry Tucker's and Art Goebel's "Yankee-Doodle" and Wiley Post's "Winnie-Mae" round-the-world plane.

The Vultee V-1A is particularly interesting because of its simplicity of construction, which makes for very low manufacturing and maintenance costs. The fuselage is of true monocoque type, without longitudinals. This construction affords the maximum possible room inside the structure for given outside dimensions and has valuable maintenance features which will be discussed later.

The fuselage is of a modified elliptical cross-section. Circular arcs of one radius form the top and bottom and arcs of a larger radius form the sides. These radii fair into each other.

The structure of the fuselage deserves special mention because of its exceptional advantages in manufacture and maintenance. A flat Alclad sheet, its long dimensions running transverse to the longitudinal axis of the fuselage, is laid over transverse U-Section diaphragms, each panel lapping back over the panel behind it. Since these panels are relatively short in proportion to the total length of the fuselage, it is not necessary to form the sheet. This type of construction is very simple to manufacture.

For maintenance in the field, it is possible to remove one or more damaged panels from the fuselage by drilling out the rivets. The damaged panels may be flattened out and, using the flattened plate as a template, a new piece of sheet can be cut and drilled. This new sheet when assembled into the fuselage, and lined up through the holes, will fit perfectly.

Repairs can be performed by any reasonably skilled metal worker, and requires no special jigs nor apparatus to keep the fuselage in line. This seems quite valuable, since most repairs on monocoque metal fuselages are factory jobs and expensive.

The cantilever wing is faired into the fuselage so that its bottom is tangent to the elliptical fuselage section. The wheels fold inwards into the leading edge of the wing's bottom surface and are completely enclosed when retracted. The wing is in three parts, a center section which is integral with the fuselage and two outer sections which are assembled to the center section by means of bolts.

The center section contains the retractable landing gear and the fuel tanks. The outer section is comprised of two parts, one a detachable nose section which carries the leading edge type landing lights and is removable in three sections, and the other a rear part which carries the principal structure of the outer wing and to which the ailerons and flap gear are attached.

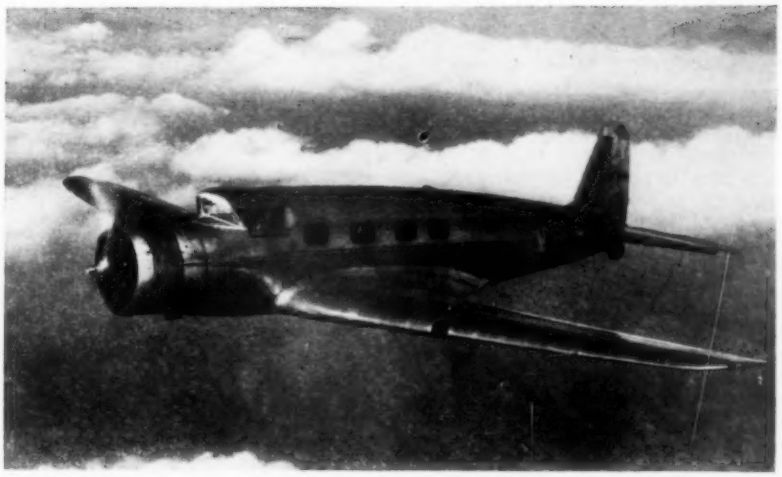
This latter part of the wing is of "shell" construction. The main stressed member is a corrugated upper and lower covering to which is attached a smooth outer wing covering of Alclad sheet. The entire wing is rendered accessible for inspection by the removal of the nose sections, since the front shear beam of the rear section is of open truss type construction.

It seems quite a sound assumption that this type of wing construction would aid materially in lowering maintenance costs, as the leading edge of the wing usually sustains most of the damage from hail, striking birds in flight and accidents on the ground. A damaged section is easily accessible for

Showing the retractable landing gear and the pocket provided for it.

is a New Note in Air-Travel

THIS new ship shows much refinement in detail over many of the recent low-wing transport planes. It is decidedly clean-cut with a remarkable performance for a single-engine transport. This plane is well worthy of your careful study.



The Vultee V-1A in flight over the American Airlines. This photo shows the remarkably clean lines of the ship to advantage.

repair or can be replaced if it is damaged too badly to be repaired.

One of the most novel and original features of the Vultee is its retractable landing-gear. During the original layout of the ship, Mr. Vultee worked toward the goal of developing a retractable landing-gear which would be both simple in construction and so positive in action and control that the pilot would require a minimum of exertion or attention under emergency conditions, and which would operate the gear quickly.

The result was a landing-gear which operated by a simple rotary motion about a pivot tube, the entire operating mechanism being a worm drive. The main member of the gear is a single cantilever duralumin strut of rectangular section. The lower end of this box-like strut contains an oleo shock absorber unit to which a stub axle is attached. To the upper end of the strut is fastened a segment of worm wheel. An electric motor drives the engaged worm and is operated by the pilot throwing a toggle switch, lowering the landing-gear in about seven seconds. No other attention is necessary on the pilot's part.

An emergency manual control and suitable warning devices are provided, including a pointer in the cockpit which indicates the position of the landing-gear at all times. With the power retracting system it is possible to retract the wheels immediately upon their leaving the ground. As stated before, the wheels are usually completely up in the wing by the time the plane clears the boundary of the field.

In addition to the mechanical simplicity of the retractable landing-gear, it appears that it is the most efficient ever devised, speaking from an aerodynamic standpoint. The wheels are carried in a horizontal position in the wing when retracted. The wheel wells are then completely closed by an automatically operating fairing which renders the bottom surface of the wing perfectly flush and which carries out the wing-section curve. The fairing plates attached to the strut and to the wing itself are clearly seen in the accompanying photographs.

The tail-wheel is partially retracted into a well in the tail, simultaneously with the retracting of the landing-gear. This is accomplished by means of a single cable which runs from the landing-gear back through the fuselage to the tail-wheel.

The wing flaps are controlled by the same electric motor and auxiliary hand crank which operates the retractable landing-gear. A small sliding gear transmission actuates the flaps. Either the landing-gear or the flaps can be operated electrically or by the auxiliary hand-crank or both can be operated together, one by the hand-crank and the other by the electric motor. An indicator in the cockpit shows the position of the wing flaps at all times and positive stop switches are provided to limit the motion of the flap either up or down.

The tail-surfaces, like the wing, are of "shell" type construction. Perhaps their most interesting feature is the fact that the fin and stabilizer are both built solidly into the fuselage. An adjustment similar to that effected by moving the fin, is accomplished by setting an adjustable flap on the trailing edge of the rudder. Similar flaps on the elevators, which are operated by means of a wheel from the pilot's cockpit, take care of the stabilizer adjustment.

In a ship as speedy as the Vultee this arrangement has quite an advantage over the conventional movable fin and stabilizer, because the loads on the stabilizer become sufficiently great at high speeds as to render its operation difficult. When the plane is trimmed by means of the small flaps, this difficulty is entirely eliminated. A solid fin and rudder also provides a much more sub-

View of trailing edge with the air-brake depressed to its fullest extent. This view also shows the detail of the wing fillet or "skirt."

stantial construction for the entire rear portion of the fuselage.

The engine-mount is attached to fittings on the fire-wall by means of precision taper bolts. These units are accurately jig-built so that the entire power plant assembly, including cowling, oil tank and all lines and engine controls forward of the fire wall, is completely interchangeable with any other V-1A airplane.

All lines and engine controls are quickly detachable so that it is not necessary to tie up the ship during engine overhaul. Instead, an overhauled power plant assembly can be installed and the ship put into the air again within an hour to an hour and a half. The removed assembly is then overhauled and kept in reserve for the next ship requiring servicing.

Ball bearings or other types of non-friction bearings are used in practically all moving parts of the plane.

The eight passengers are seated two abreast in the cabin with a 12-inch aisle separating the seats. The seats are specially designed for the ship and are adjustable to six positions. The cabin is 68 inches high and 58 inches wide, affording ample room for a comfortable seating arrangement.

Behind the last seat is located the main cabin door, on the right side of the ship. Immediately opposite the door is a fully equipped lavatory which is so arranged as to afford maximum room when in use. Just behind the lavatory is the baggage compartment and behind this is the main radio installation.

Western Electric acoustic engineers sound-proofed both the passenger cabin and the pilot's cockpit. It is said that the cabin is quieter than a Pullman car and that it is possible to talk from one end of the cabin to the other in a normal tone of voice while cruising at 215 m.p.h. In addition to the extensive use of insulating material in the walls of the fuselage, noise filters have been applied to all ventilators and heater openings. The low noise level obtained is 68 decibels.

The passenger compartment is separated from the pilot's cockpit by a sound-proofed bulkhead which has a door through which the pilots enter. A forward slanting vee type wind shield is used and is designed to eliminate glare from lights on the ground and affords good forward vision even in heavy rain. The pilot's cockpit is sound-proofed in the same manner as is the passengers' cabin.

Since the ship is designed primarily for use on scheduled air line routes, it is fully equipped with night flying instruments, two airways 3-minute flares and complete Western Electric two-way radio installation. To date, one ship has been delivered to Pan American Airways and is being tested for several of their land routes.

American Airlines, for which the ship was undoubtedly primarily de-

(*Concluded on page* 119)

Stinson Airliner on Preliminary Flights

The Stinson Airliner flying over the city of Detroit on its preliminary test flight.

AFTER eighteen months of hard work, the Stinson tri-motor Model "A" has been given its preliminary flight tests which indicate a cruising speed in excess of 150 m.p.h. This figure, set out as the minimum, has proved the truth of the wind-tunnel experiments. The take-off and climb characteristics are excellent.

The tests proved, according to information from the Stinson factory, that the braced gull-winged wide fuselage job is as fast if not faster than current conventional type jobs. It should operate at a lower cost per mile than many ships of its capacity which was the objective of the builders from the beginning.

Santos Dumont's Early Box Kite

ALBERTO SANTOS DUMONT, the Brazilian "Early-Bird," conducted an extensive experimental campaign in aeronautics at the same period as the Wright Brothers.

His first attempts at flight were made with miniature airships or dirigibles with which he was conspicuously successful, and he later tackled the heavier-than-air problem after winning a number of prizes with his airships. For many years, it was claimed that he was the first man to make an airplane flight in Europe, but within the past few years, a Danish pilot has put forth claims for this honor. However, no matter how insistent the claims of the Danish experimenter may be, after all these years, we will still consider Dumont as the European Early Bird for we have little confidence in post-event history making.

The plane pictured below is the ship on which Dumont made his first flight, November 12, 1906. He introduced the dihedral angle on this ship, as will be seen, and attempted to counteract skidding by adopting the vertical "skid curtains" shown between the planes. This was a canard or tail-first affair as were the majority of the early planes. A number of sustained flights were made and then Dumont turned his attention to the "Demoiselle," the world's first lightplane.

Here is Santos Dumont's celebrated canard biplane box-kite all ready for a hop.

The Adventures of Capt. Ball

by CARL B. OGILVIE

Capt. Ball, the great British Ace, was an interesting and astonishing personality. He was only a boy during the war—20 years of age when he was killed—but he fought and led men of far greater age.

HE WAS just a boy. He tied a small cloth toy kitten to an outer bay strut of his Nieuport as a talisman of good luck.

Once, when jagged pieces of shrapnel missed him by a scant half inch, he dug the shrapnel pieces out of the seat of his plane and sent them to his parents as proof that flying battle skies was not really dangerous. Returning from dog-fights with enemy pilots, where sudden death lurked every second, he would sing lustily, happily—a boy victor singing, giving voice to the joy of having won another victory.

He attended church every Sunday. Then went back to fly and kill, to sing and pat his cloth kitten for his good fortune. He was a boy of eighteen when he enlisted. He was only twenty when he fought his last battle in blood-drenched skies and was shot down. Still a boy. That boy was Captain Albert Ball, the Boy Ace of the Royal Flying Corps.

Despite his extreme youth he flew and fought with men. He was a boy among men, engaged in a desperate man's game—war. And he proved himself every inch a man. Ball engaged in hundreds of sorties with enemy pilots. He shot down 43 German planes and one observation balloon. He was shot down seven times. This lad was promoted to flight leader . . . captain . . . and then leader of Squadron 56—England's most famous squadron.

This boy fought men, led men and lived a clean man's life among men. He was one of the early aces of all the Allied air corps. He was one of the very few Englishmen to receive the Military Cross, the Distinguished Service Order with two bars, and the Victoria Cross from England.

He was the youngest and for a long time the best pilot on any front. He was the first pilot to use acrobatics in fighting. The story of his fifteen months' service at the front in the air service is one of the most astonishing stories of the war. It shows what boys can do in aviation.

Albert Ball was eighteen that August day in 1914 when the war clouds burst over Europe. Lord Kitchener was calling for volunteers. Ball recalled the words engraved above the Armory door of the Cadet Corps at Trent College where he was a student. They read:

"England expects every man to do his duty."

Ball promptly went to the nearest recruiting station at Nottingham, where his father had once been mayor. He was assigned as a private to the Sherwood Foresters. Thus Ball became a soldier in one of the famous volunteer armies of history—"Kitchener's Mob"—"The First 100,000."

But, when Ball found out that the Foresters had no orders to "go out" to France, he was bitterly disappointed. He requested a transfer to the North Midland Cyclist Corps. They were "going out." But with the cyclists Ball didn't go out. They made him a bloomin' sergeant and he was eventually transferred to the Officers Training Corps.

Here he bought a second-hand motorcycle. After a hard day's drill he'd study in the evening, go to bed early. At three in the morning he would get up. By riding at a 60-mile-an-hour speed Ball was at the Ruffy-Beaumann flying school at Hendon by four o'clock. The lesson lasted an hour.

A portrait of Capt. Albert Ball by Mrs. Ogilvie.

By racing back, Ball was in camp at 6, just in time to fall in line with the other student officers. It cost Albert $500 to learn to fly. After being commissioned a second lieutenant of infantry in the Nottinghamshire and Derbyshire Regiment, he requested a transfer to the R. F. C. On October 15, 1915, at the age of nineteen, he obtained a pilot's certificate, No. 1898, on a Caudron.

Flying a faster machine than he had ever flown, Ball cracked up on his first flight with the R. F. C. An angry instructor-officer threatened to send Ball back to the Infantry. Ball replied he had paid his own tuition and other R. F. C. men had not. He took off again and made three perfect landings. On January 26, 1916, he received his wings. In February he reported for duty with 13 Squadron on the Flanders sector.

The first ship Ball flew at the Front was an old B.E. crate, 30 to 40 miles an hour slower than the trim German Fokkers. He flew with an observer on artillery spotting duty.

Ball displayed marked promise as a fighting pilot. He was assigned to a Bristol Fighting-Scout plane by this C. O. Then Ball knocked the R. F. C. out of their seats and the Jerries out of the Flanders sky. Like Guynemer, Ball fought furiously, daringly. His tactics were: attack—fight—kill! He threw himself into the fray against any number of enemy pilots; disregarding personal safety he won one victory after another by the ferocity of his assaults.

BALL was small of stature and of nervous temperament. His was the face of a good looking fighter. His energy was dynamic, boundless. When on the ground he spent many hours in the hangars, or practicing at the gun targets. Other times he worked in a garden he had made at the airdrome. The pilots laughed at his flowers, but enjoyed eating his vegetables.

The people of England never heard of Albert Ball until after he had shot down his 22nd enemy plane. The British did not mention their aces by name in their *communiques.* In the September 11, 1916, issue of the *London Daily Mail* appeared the following:

"Lieutenant Albert Ball, eldest son of the former Mayor of Nottingham, has brought down twenty-two enemy aeroplanes. In a letter he tells that he has had eighty-four aerial combats and that one night upon being attacked by four enemy machines, he brought all four down."

Attached to Squadron 11, Ball learned to fly a Nieuport. He was one of the only two British pilots at that time that knew how to handle the tricky French plane. By June, 1916, he had a record of a dozen more fights than any other pilot in Squadron 11. Read the citation he received with the Military Cross:

"For conspicuous skill and gallantry on many occasions—noticeably when, after failing to destroy an enemy kite balloon with incendiary bombs, he returned for a fresh supply of ammu-

nition, went back, and brought it down in flames. A distinguished chaser; on one occasion he attacked six enemy aeroplanes, brought two down and put the others to flight."

The Boy Ace, nineteen by now, had shot down five enemy planes and one balloon. He was allowed to "slack" for four days and went to England to see his family and fiancee.

A legend has grown up around Albert Ball's supposed duel with Max Immelmann. The story is to the effect that Ball repeatedly dropped challenges on the German airdrome and finally Immelmann, on June 18, 1916, to save his face, went aloft, fought Ball and was shot down to his death.

This is a very colorful story and one into which Ball would fit nicely, only for one thing. Ball was on leave in England at the time and did not return to the front until June 22nd. Ball did, however, have many desperate battles with Immelmann, Richthofen and his Flying Circus, and once flew to the baron's 'drome and dropped a challenge to Richthofen to come up and fight. A challenge the "Bloody Baron" never accepted. Was he afraid of the great British ace?

On July 8, 1916, Ball fought twelve battles. He got his second "pip" and was now a first lieutenant. He celebrated his birthday, August 21st, by being made Acting Flight Commander of Squadron 11. He went up eight times that day.

Flying his favorite ship, a French Nieuport, he met five enemy planes on his first flight that day. He shot one down and forced two more down. But read the excerpt from the letter he sent home to his parents in which he minimized his close call from death:

"It is an ill wind that does not blow someone some good. I hope it also blows at home. Indeed, I'm too lucky for any one man alone.

"On August 22nd (1916) I go out on patrol and encounter a flight of twelve Huns. I pick out one and dive in. First fight; I get into position and fire two bursts. The biplane falls just at the outskirts of a small village and is absolutely demolished. Second fight: I peeked down below, then zoom up under another with fingers on the trigger.

"Two bursts from my guns and it is on fire, then it streaks downward leaving a trail of black smoke wreathing up into the sky. Third fight: I bank steeply, then dart into an attack again. I fire one burst and the enemy plane falls and crashes upon a roof top.

"All of these fights were witnessed by others who have vouched for the results. I only picked up eleven bullet holes in my own machine.

"I went back to the 'drome for more ammunition and went out on patrol again. This time my luck was not exactly the same. When flying 25 kilometers within the enemy lines, I suddenly found myself face to face with 14

(*Continued on page* 118)

Well, Well, Well, Whaddye Think of This Hoax?

This is what our European friends call a "hoax" which is just another word for "April fool to you" in this country. It just goes to show that trick photography is not dead yet, although we have the solemn assurance of a news agency that this flight actually took place.

ERICK KOCHER, a European pilot, provided himself with a pair of Flettner rotor cylinders, put an air engine between the cylinders and then literally blew himself up into the air—so they say.

Blowing into the air-engine rotates the Flettner cylinders and, when he faces a sufficient breeze, Kocher ascends in a more or less graceful attitude until his wind gives out. It certainly must be a weird and thrilling sight to see Mr. Kocher take off on the skiis and with the tail skid projecting to the rear from his hips, but still there is something about the whole deal that makes us more than a little skeptical. True enough, this flight was shown in the movies and here we have a photograph of the act that is supposed to be authentic, but . . . . .

Now, it is easy to understand how a considerable amount of lift can be obtained from the Flettner cylinders. That part is all right. But, on the other hand, it would seem that more than lung-power would be required to rotate the cylinders under such conditions. We can't help but wonder if it doesn't work best after the pilot has reinforced his blowing apparatus with a good stiff meal of limburger cheese and sauerkraut.

If so much can be done with the breath, then a whole lot more could be accomplished with foot-power or hand-power. We, be it understood, are not vouching for the truth of the display, neither are we knocking it, but are just presenting the pictures to you as they were presented to us. We'll be in a stew until we find out more about this stunt, which should prove the world's greatest vaudeville act.

Here we have Erick Kocher, blowing himself for a good takeoff. Some breath, has this bird, if he can blow a motorcycle engine around at flying speed.

Member No. 1—Caterpillar Club

by HELEN S. WATERHOUSE

A thrilling story of how the first member of the famous Caterpillar club became eligible for admission to this select body. Few become members by choice and Mr. Wacker's initiation was sure rough.

IT was July 21, 1919, when the first Caterpillar of the now famous Caterpillar Club came into existence.

The story of Henry Wacker's leap in an old Spencer-type parachute from a flaming airship and his crash on the seventh story cornice of a building from which he fell two stories to a fire escape is one of the high spots in the saga of lighter-than-air. But this thrilling page of airship history has been left out of most aviation books.

While the experiments of Count Zeppelin, the triumphant flights of the Graf Zeppelin, the Akron and the Macon, and even the Shenandoah tragedy are pretty well known, the name "Wingfoot Express" suggests nothing to the average person. Yet the Wingfoot Express was the first commercial passenger-carrying ship ever built by the Goodyear-Zeppelin corporation before it was called by this name, and in the days when army airships had been successfully built by the Goodyear and flown from the army field in Akron, Ohio.

It was with all confidence, therefore, that Goodyear launched its new project, a commercial passenger-ship, built to carry eight people. Since there was no hangar large enough to hold the 200,000 cubic foot ship in Akron, it was shipped to Chicago where it was assembled ready for flight at the only available hangar of that time in White City Park.

The ship was a non-rigid filled with hydrogen of the regulation cigar-shape, with an open gondola suspended below the bag and two motors in the rear.

A mechanic in the back of the gondola took signals from the pilot in front. Jack Boettner, who had taken training in lighter-than-aircraft handling and who has since been in charge of the Goodyear blimp fleet for many years, was the pilot on the ill-fated trip. And Henry Wacker, also a trained lighter-than-air man, went along as observer.

The Wingfoot Express landing. Note the position of the elevators.

"I can still picture the other poor fellows who went with us, thrilled at the prospect of being the first airship passengers in an American-built commercial ship," said Wacker. "There was Norton, a newspaper camera man from one of the big Chicago dailies. There was Davenport, a publicity man from White City Park and Buck Weaver, our motor mechanic.

A close-up of the rotary engine suspension which may or may not have been the cause of the trouble.

"The ship had already made a successful trial flight or two out over the lake. It had made its first landing at Grant Park, where the two Goodyear ground-men in charge of operations, Herman Craft and Bill Young, who had come over from Akron with the ship, were promptly arrested for landing in a park without a permit. This little difficulty having been successfully ironed out, the ship once more took off with two army officers as passengers and returned safely to Grant Park.

"Then we five climbed in ready for a last trip back to the hangar," related Wacker. "We circled out over the lake at 2800 to 3000 feet, riding along smoothly and easily. But suddenly, as we swung in again over the city, the ship gave a lurch. It was so much of a lurch that I realized immediately that something was wrong, and being the only trained airman on board with the exception of Jack Boettner, I left my seat and looked arund to see what happened.

"I checked to see if a suspension rod had let go, and looked over the rudder and elevators, but couldn't find anything wrong. Hardly had I sat down again, however, when there came a much bigger lurch or bump. This time Jack also stood up and said 'Something must be wrong.' And at that moment I discovered that the left hand side of the bag, about at the equator line of the ship in the rear, was all in flames. Ten chances to one it was static which had caused it, though I didn't stop to figure that out then.

"The passengers were all very calm and quiet, not realizing that anything serious was happening and unaware of the fire. I knew immediately that the

ship was doomed and I told Buck Weaver to jump. Fortunately, we were all equipped with parachutes. Then I hollered to Davenport who was behind me to jump and Boettner told the others. It all happened in an incredibly brief space of time.

"I remember I waved goodbye to Jack and let my body fall over the edge of the ship. Being an old type parachute, it fell 150 to 200 feet before opening. I looked up but couldn't see the ship or any part of it, but I did hear a big noise. Then I saw with horror that my own parachute was on fire in two places. It had apparently become ignited from the flaming bag as I left the ship.

"I watched those two holes smouldering as I fell slowly towards the earth. As they grew larger, the air blowing through them started the chute spinning. Just as I had about given up all hopes of ever landing safely, I saw with relief that the fire in my chute was dying down, and presently it went out.

"My next concern was where was I to land, since I was coming down directly over the heart of Chicago. I remember passing one of the tallest buildings of that day, I believe it was the Gas building, and I missed it by a distance of only fifteen feet. In fact, I passed so close to that building that people leaning from the windows to watch the flaming balloon, reached out their hands and tried to grasp me as I went by.

"Then, to my horror, I saw that I was headed directly for the elevated railroad and all the stories I had ever read about the fatal third rail came into my head. I was afraid that my parachute would drag me right on that rail and I resolved that, after getting a bit closer to the earth, I would cut my parachute so that I would drop clear of it and not be dragged.

The Wingfoot Express falling. Note the three open parachutes at her side.

Henry Wacker, Member No. 1 of the Caterpillar Club who describes his escape from the burning blimp in tais interview.

"The spinning of the chute was terrific by this time and, on that account, I was unable to see the building into which I suddenly crashed. I hit a cornice on the seventh story and the force of the blow made my parachute collapse. I then fell two stories to a fire escape on the fifth floor of the building. My chute was still attached to a vent pipe on the seventh story when they found me.

"Everything was blank for nine days after that. When I came back to consciousness, I found myself in the Chicago Presbyterian Hospital with two skull fractures, all my ribs broken, a badly injured back and my right arm completely torn from its socket."

It was then that Wacker learned the tragic story of the disaster. The bag had burned completely in mid-air. The gondola and engines went hurtling down through the skylight of the only low structure in that section of the city—the Illinois Savings and Trust Bank. Eleven people, including bank employees and bank customers, were crushed to death beneath the heavy weight of the big engines and gas tank. And of the five passengers who had set forth so gaily in the Wingfoot Express that Monday morning, only Jack Boettner, the pilot, and I had survived the crash.

Jack, it seemed, had been the last one to leave the ship. The flames were beating in his face as he jumped, and he burned one hand badly in shielding his face from them, but that was his only injury. While his chute, as well as Wacker's and all the others caught fire, he was within a few feet of the roof of a building when it finally burned through, and released him. He dropped with a hard bump, becoming Caterpillar Number Two.

When the question arose later, as to whether Wacker or he should be termed Caterpillar Number One, Jack

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Here's an Idea for CWA Airports

by F. F. FRAKES

In my journeys around the country, pursuing my stunt of giving airplane crash exhibitions, I've seen a lot and heard a lot about the many CWA airports that are becoming a big burden and a problem in many communities.

What to do with all these airports that have been constructed by CWA squads? There they lay in the sunshine with never an airplane coming near to them for months. "All dressed up and nowhere to go" is an expression that applies to most of them. Soon they'll be over-run with weeds, the runways will disappear and the whole project will come to an untimely end.

Well, I believe that I have a solution for this problem that will be of assistance to aviation in general and the CWA airports in particular. And this suggestion will solve several more problems at the same time dealing with surplus army pilots and about a million or so of our young women and men who wish to learn how to fly.

In short, why not station one or more Army Air Corps officers at the CWA airports and give flying lessons at a very low figure. This would be useful training for the officers and a great boost to the aviation industry because it would bring the public into direct contact with aviation for the first time. Just so long as there are two trained army pilots for every serviceable plane in the army, we can use them to great advantage in this work, and the cost to the government would be very small in view of the results obtained.

Many of the obsolete, but still serviceable government airplanes, can be used for this purpose, which with a relatively small additional investment by the government in new training planes, will quickly build up a tremendous air reserve and further—will keep them in training.

It will be the duty of many of the officers to act as instructors in case of war, and such an arrangement will give them excellent training in teaching flight—just what they need to fulfill their purpose. If any of you fellows are interested in a movement of this kind, I would be glad to communicate with them through POPULAR AVIATION.

New Use for Old 'Chutes

THE Texas National Guard, following the national economy trend, has put ten parachutes, condemned for human use, to other work. The 111th Observation Squadron has rigged out the 'chutes with five-gallon milk cans, these to be loaded with supplies for marooned parties in the marshy coastal sections of Texas, or to carry food, drink and ammunition to them. Because of frequent floods, the Squadron has often been called on to aid groups caught by rising water.

Aviation Stunts in the Movies

by "HOLLYWOOD"

How mechanical ingenuity adds to the realism of aero movie thrillers and how the laboratory assists the actual stunt flyers in making a film story.

AIRPLANES suspended from cables—either outdoors or in—furnish many of the air thrills that you see on the screen. Some are real planes, capable of flying. Others are "prop" ships, built in some studio carpenter shop, that crash before the cameras for the final scene.

In one recent comedy, two actors appeared to face death high in the air, but their plane hung from a giant crane only 12 feet above the ground. The cameras looked directly into the ship from a nearby platform while wind machines created a gale across the wings and men swayed the plane by wires attached to various points on the plane. Later one of the comedians received a resounding blow on the head from a propeller made of light balsa wood but with no injury.

When filming such a picture, including a perilous take-off, stunt pilots put the ship through its intricate maneuvers in the air before it is suspended from the crane for the actors to do their bits. Then the propeller is removed, as it cannot be seen when revolving and the plane appears to be in flight.

Since it is nearly impossible to record conversations in an open plane while flying, some of these scenes are filmed indoors. Then the camera shoots "through" the plane directly into a glass screen on which appears scenery. This "double shot" records closeups of the plane and actors and the scenery as it normally would appear. Parts of the plane "blank off" parts of the scenery, leaving a normal completed picture.

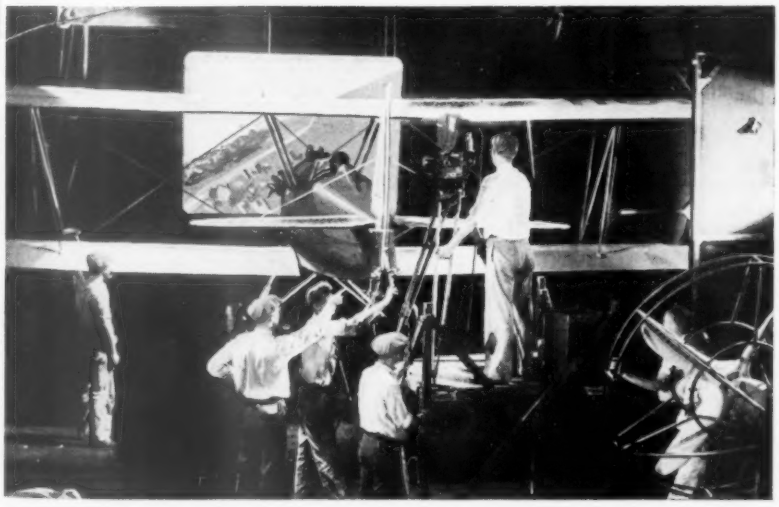
Slow evolutions of an airplane are often worked out safely by supporting the plane from a derrick by invisible wires (shown dotted above).

The production of the latter type of studio picture requires synchronism between the camera and the projector that is throwing the scene upon the screen, as was discovered when this sort of picture was first attempted. The camera shutter and the projector shutter must open and close at the same moment to avoid flickering and offsets on the completed film.

With the ship hanging from a derrick, as in the picture at the top of this page, almost any old pilot or non-pilot can attempt the most startling stunts without danger, and at the same time, the plane is always within easy range of the camera which is also a practical feature appreciated by the studio. Taking sound pictures has been largely instrumental in faking pictures that are perfectly easy for the camera in normal flight. This is for the reason that the roar of the engine must be eliminated in order to shoot the voice.

In one picture made within recent months, the script called for the plane to crash in a narrow street between high buildings, and as this was a job that even the most hardened and experienced crash pilot turned down, the inventors went to work on a mechanical device by which the stunt could be worked without danger. A steep chute was run down from the top of one of the buildings, terminating just above the field of the camera and when the property plane roared down the chute and crashed in the street the effect was highly effective.

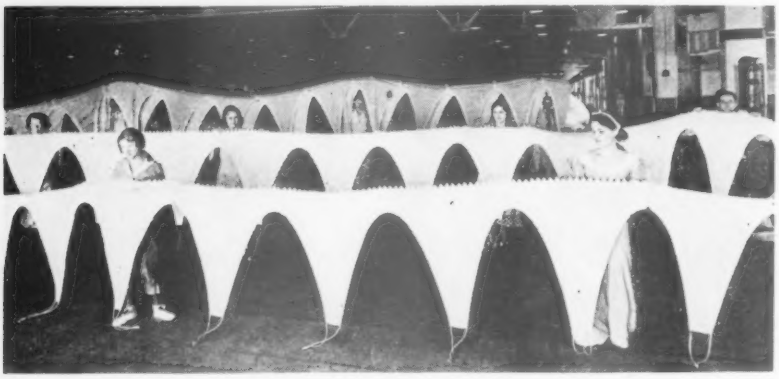
But all flying pictures are not faked in this manner—far from it. Skilled pilots and real planes are employed by all of the studios in their flying pictures. If you have attended the air-races you, no doubt, have seen the antics of those wonderful movie stunt pilots—"The Hollywood Trio."



Making a closeup sound picture of the cockpit and pilot while the rolling gyrating scenery is being projected on the square screen shown in front of the plane.

Dope on the New Stratospheric Balloon

by HELEN S. WATERHOUSE

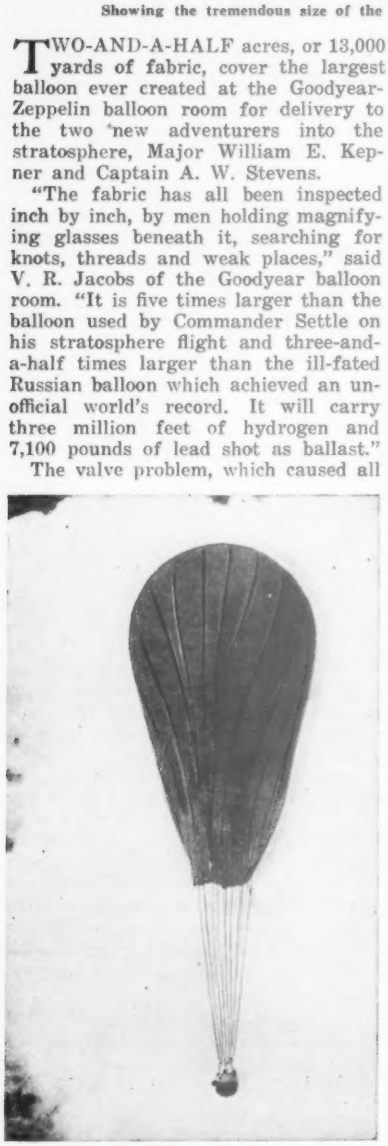


Showing the tremendous size of the skirt of the new stratospheric balloon.

TWO-AND-A-HALF acres, or 13,000 yards of fabric, cover the largest balloon ever created at the Goodyear-Zeppelin balloon room for delivery to the two new adventurers into the stratosphere, Major William E. Kepner and Captain A. W. Stevens.

"The fabric has all been inspected inch by inch, by men holding magnifying glasses beneath it, searching for knots, threads and weak places," said V. R. Jacobs of the Goodyear balloon room. "It is five times larger than the balloon used by Commander Settle on his stratosphere flight and three-and-a-half times larger than the ill-fated Russian balloon which achieved an unofficial world's record. It will carry three million feet of hydrogen and 7,100 pounds of lead shot as ballast."

The valve problem, which caused all of Settle's trouble on his unsuccessful Chicago attempt last year, has been "licked" on the new balloon, according to Jacobs.



A wash-drawing of the new balloon at a low elevation.

"It was no wonder that a 350-foot long valve line got tangled in the fabric," he said. "There are no valve lines on this balloon. Instead, 400 feet of standard automobile hose, such as is used for inflating tires at service stations, with a stop cock on it, will be used. And the first and only pressure-actuated valve, the cleverest thing in lighter-than-air gadgets ever made—an invention of Captain Stevens' own—will be employed."

This means that the oxygen supply can be controlled from 300 feet below, by a gentle pressure on an ordinary foot pump, and that the pilot can be watching a gauge at the same time. Tests of the gadget, made at Wright Field, Dayton, have determined that it will not be affected by the freezing air of the stratosphere.

An advisory board of scientists, which has planned 16 major scientific projects for the two men to carry out on the flight, will be on hand at the take-off. Because Captain Stevens is one of the world's outstanding aerial photographers, a collection of cameras of a most unusual nature will be taken aloft.

One camera will have its focal length graded by the Bureau of Standards, with a specially-made lens on which condensation is impossible. Through a hole in the bottom of the gondola, pictures will be taken of each level as the balloon ascends, and inside the big camera, a smaller camera will be simultaneously taking dial readings. Other cameras will register the electrical gradient of each level and the barometric altitude.

"Commander Rosendahl once said that faulty altimeters might have had something to do with the Akron crash," said Jacobs. "Altitude tables always differ greatly. If these camera records prove successful, they should correct for all time the altimeter problem, and

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Let Us Laugh

NOT that I want to worry you, but maybe you'll feel a little sympathy for the old lady who spoke apologetically to the pilot of the plane in which she was flying.

"Excuse me, Sir," said she, "but I'm a bit nervous. This is my first ride in an airplane."

"No need to apologize, Madam," replied the pilot, "it's my first flight, too."

And this story is related to the yarn about the man who rushed up to an airport and, seeing a man standing about in a uniform of some kind, told him that he was in a hurry to take a plane, and asked him if he could fly.

"I don't know," drawled the stranger, "I never tried."

And this leads us to remark that pilots may be said to have short tempers, due to the fact that they "go up in the air" so often.

But, anyhow, pilots have a lot to put up with, at that. For example, there was one who was taking a man up in sight of a crowd of people. The plane rose to about three thousand feet, according to the story, when the pilot started doing stunts, dips, rolls and the like. Finally, straigthening out, he brought it down to a safe landing Laughing, the pilot said to his passenger:

"I suppose fifty per cent of the people on the ground thought we were falling."

"Yes," said the passenger, his cheeks still pale, "and fifty per cent of us up in the air thought so, too."

And this, in turn, leads to the observation that the most deadly poison known to science is "airplane," because one drop is fatal.

But, then, high flying is not the only danger in aviation. There is also the peril in flying too low. And the village fathers of a certain small town were discussing ways and means of preventing the risk to life and limb of the citizenry occasioned by low-flying planes skimming the roofs of their town. One of the members of the board asked how the offending planes could be caught. Another member wittily replied with the suggestion, "Put salt on its tail."

This aspect of aviation, namely, looking at it from the ground, may be illustrated by the story about the small child who was walking with his father one day when he saw a plane in the sky.

"Look, Daddy," said the child, "there's an airplane."

"Yes, dear," cautioned the parent, absorbed in thought, "don't touch it."

From such an untouchable altitude, a flyer may be at a loss sometimes to know how to descend to the ground safely. This may be done as a friend of mine relates that he did, namely: he stared at the pilot, and the pilot stared at him, thus making a pair of stares, down which they both walked to safety.

And I, being at a safe distance, close with a wish for a Happy Landing.

Yarns Spun Along the Airways

by T-2003

Wandering leisurely along, from airport to airport, the author has heard and recorded a number of interesting stories told to him by the oldtimers.

THE open-cockpit two-seater came sailing in over the hangars just a bit too fast. The fresh breeze blowing over Pittsburgh's hills was hardly noticeable here in the hollow that holds Rodgers Field, the local Army Air Corps reserve station.

Half way up the runway, the wheels touched—tail still up, lots of speed—'way too much. The fence loomed up, the pilot slapped on the brakes and the tail reared up—I thought of the 95th Squadron's kicking mule insignia when it did. Only it didn't take all this time.

What really happened was the "Scr-r-p-p" of locked tires sliding on cinders, "Flip" the tail snapped up and the nose ducked down—and right then 160 pounds of passenger was flung out of the rear cockpit to land almost a-straddle of the pilot's neck!

Captain Sammy Eaton, field commander, was hollering for a coupla mechs to pull her tail down, six seconds before it even happened. Being 15 years in the flying game develops a sixth sense. "Ride 'im, cowboy," he shortled as said rear seat hero did his leap. "The manufacturer puts belts in every cockpit, but don't mind *that*," he added.

Well, they got her tail down and only one prop tip was screwy, so they took the "wow" out of it gratis and in an hour or so the pilot took off again, this time *down-wind*. Meantime, the captain was regaling me with *his* views of keeping the belt on.

"After the Armistice," he said, "and before I came back into the regular Army Air Corps I used to fly the mail.

The world's record dive.

And was his face red when he saw the emblazoned chisel?

Wooden DeH's. In case of forced landings most of the boys would unhook their safety belt. Why? Well, you see jagged splinters from wooden longerons and hot fires were usually present in the crashes of those days and far better to get 'flang out' and go sailing, unassisted into space when the old crate washed out, than to stay and suffer with it. However, in *these* days I feel the belt is there to be *used*. And as for forced landings in water, hah! let me tell *you* one."

"I was in Panama with the old 7th Squadron at France Field. Being situated right on the shore of a cove of the Caribbean, aquatic sports were naturally popular in our off moments. For a while we copped all honors in the intra-post swimming meets.

"One lad really was the whole team, a tall corporal who was crew chief of one of the planes. In the swims he could beat a barracuda—in most of the dives he was a model of grace. Only one thing phased him, the dives from the 30-foot springboard. He'd move all through a meet winning point after point, but on the top of the tower—well, he'd just go all to pieces. Too bad, as he'd have been a world-beater except for that fear of the really high dive.

"But to make a long story short. An athletic meet was scheduled on the Pacific side and early that morning the contestants from our field were flown in transports and DeH's to Albrook Field across the Isthmus. I was flying the captain of our water-polo team, and this corporal was being flown in a DeH in formation with me.

"About one-third way across, darned if the Liberty in that other DeH didn't conk, and down it glided, for a big splash in Gatun Lake, with its dreary forest of dead flooded trees. The pilot headed into the wind and stalled her in as slow as possible, but she sure nosed in suddenly when she splashed.

"And then, having in a misguided moment unlatched his safety belt, our hard-swimming corporal shot out in the prettiest, highest and longest dive ever witnessed by mortal man. The DeH stopped from 60 m.p.h. to zero in four seconds, but not the corporal. For many seconds he floated through the tropical breezes. I was witnessing the unofficial world's record long dive. I could see him gather himself as he went and assume a diving position.

"With only inches to spare he slid between two dead mahogany trees and slipped into the water. It was noon before he and the pilot were picked up, but he got to the meet.

"The super-dive that morning in Gatun Lake must have taken all fear of such high dives from him, for he sure cleaned up in the swan dives, double garners, et al., from the high springboard. As I mentioned before, he'd have been a world beater, only—"

"Only what?" I cut in on the captain's story, "You said that only fear of heights kept him from being a world champ, and now he was no longer afraid of the 30-foot dive, yet he still wasn't—"

"Sure—I know what you mean. Only now he was no longer afraid of heights when standing out on a narrow board above water, but his forced landing had

Why I left aviation for a more profitable field.

transferred that former 'acrophobia', or fear of heights, into one of flying. You couldn't drag him into a plane after that.

"Well, most athletic meets for the soldiers were held on the other side of the Isthmus and though he wouldn't let himself be flown across, he was kinda ashamed of going over by train with a bunch of coast artillerymen and doughboys. So he didn't go in for swimming much. So you see what can come of unlatching your safety belt too soon."

* * *

FROM Pittsburgh to the State of Nebraska. Nothing of importance really happened between them. I thought of the first time I had made this trip in an OX powered Jenny with a passenger. A great crate and a great trip. We had had a speaking engagement at a city not awful far from Omaha but strong West winds delayed us, so that we made the last two-hour hop after dark.

No lighted airways in those days, in 1920, when men were men. When we came to our destination there was a row of autos with headlights blinking on and off to show us, in the air, that this was the field.

After the formal banquet, not in our honor but for someone really important, we drifted along with some local boys, to some club or other. The evening waxed merrily on.

"Wantyatameet 'n ol' timer, ol' timer, I mean 'n ol' timer," said our host as he led me over to a sad looking gent in a corner. Introductions completed, mine host wandered away and left Ol' Timer and me together.

"One of the early settlers here, eh?" I asked.

"No, worse than that, an Old Time Aviator," said the Old Timer. "I used to fly 'em myself—once. Was thinking of your speech tonight. Oh, I was there all right. You were talking of the future days when 'luminous trails will traverse this continent,' when 'Sleek monoplanes will dart from city to city, their wheels tucked up inside recesses in the fuselage, and ailerons acting as air-brakes for short landings.'

"Well, it was a lot of good prophecies, though I doubt they'll ever come true, but you weren't the first to tell that bunch of fatheads all about it—*I* was. Back in 1915. That's why I'm here in this awful town." (Yet he had built up a small fortune in that "awful" town.)

"I come barging here in a 'pusher' that even then had seen better days. The local people arranged my exhibition and there was the usual speech at which the usual prophecies concerning aviation were made. Next day, Saturday, was spent in flying the yokels around at 5, 10 and 15 bucks per throw. Took up 82 that day, and labored likewise all the following Sunday.

"Then comes a couple conventions or something into town during the next

(*Concluded on page* 128)

An Aviation Engine Quiz

by P. A. TECHNICAL STAFF

Q. Is it possible to determine the pressure at different points in the piston travel?

A. Yes. There are pressure indicators of various types which record the pressures on paper or else photographically trace a curve showing the pressure variations.

Q. Is there any practical use for these indicators?

A. Yes. They show whether the valves are opening and closing at the proper point, whether the ignition occurs at the proper point and many other quantities so that the proper adjustments can be made. The mean effective pressure can also be determined in this way by measuring the area of the record.

Q. How is the speed of a gasoline engine engine controlled?

A. By means of a damper or valve known as the "throttle" which controls the amount of mixture going to the engine from the carbureter.

Q. How does this regulate the speed?

A. It controls the weight of fuel going into the cylinder, and by this means increases or decreases the mean effective pressure.

Q. Does this affect the efficiency of the engine?

A. Yes, when the throttle is closed beyond a certain point, the amount of air taken in is so reduced that the compression pressure is also reduced, hence the power and efficiency drop at this point.

Q. Does this change the quality of the mixture?

A. Almost all carbureters are compensated in such a way that the mixture is leaner or carries proportionately less gasoline at high speed and is richer or has more gasoline at low speed.

Q. What effect has altitude on an engine?

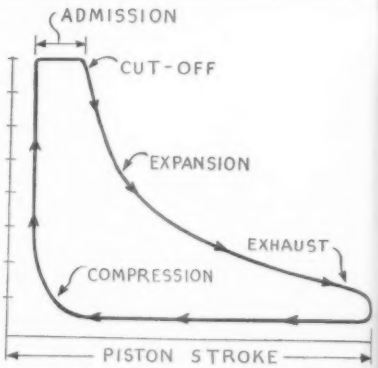
A. Variations in altitude very greatly affect the performance of an engine. At high altitudes, the air density is less, hence a smaller weight of air and gasoline are taken in at each stroke of the piston. This reduces the power output.

Q. Is this effect very noticeable?

A. Yes. At 10,000 feet above sea-level, the engine pulls in hardly enough mixture to overcome its own friction and gives practically no propulsive force unless assisted by a supercharger.

Q. What is a supercharger?

A. It is an air-pump or blower connected to the intake side of the engine so that the mixture pressure is raised approximately to the air-pressure at sea-level. The engine now gets its normal charge of mixture independently of external atmospheric conditions.



A steam-engine indicator-card.

Q. How are the superchargers driven?

A. By the exhaust gases of the engine acting on a small turbine wheel, by gearing, by electric motors or similar means.

CARBURETERS

Q. How is a carbureter constructed?

A. The simplest possible carbureter consists of a small nozzle placed in the inlet connection to the engine, this nozzle being connected to the gasoline tank through a float valve that holds the gasoline at a constant level.

Q. How does this operate?

A. When the inlet valve opens on the engine, the suction of the piston draws in a current of air and at the same time, draws gasoline out of the nozzle in the form of a fine spray. This gasoline spray mixes with the air and when drawn through heated passages, vaporizes and mixes more thoroughly with the air to form a combustible mixture.

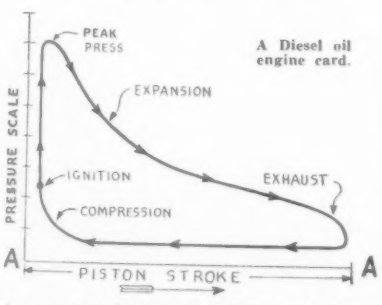
Q. Must heat be applied to the gasoline for vaporization?

A. Vaporization is necessary and heat of some degree is necessary for converting the liquid spray into a vapor. With very volatile or easily evaporated gasolines, the temperature need not be high but still heat is needed.

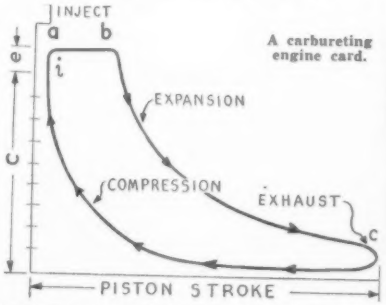
Q. What does the heat do?

A. It drives the gasoline molecules farther apart.

(*Concluded on page* 132)



A Diesel oil engine card.



A carbureting engine card.

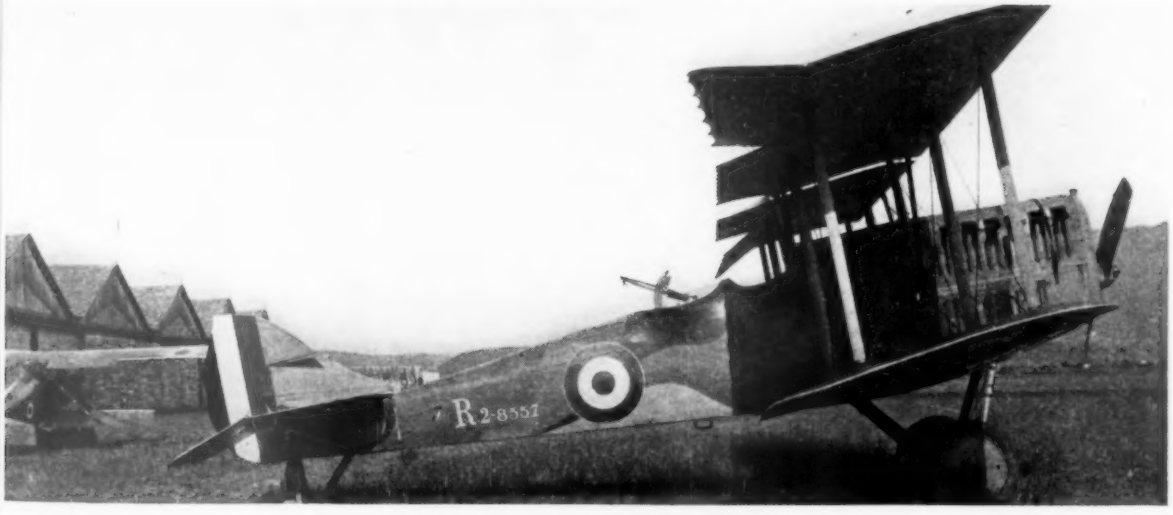
A comparison between an indicator card of a carbureting engine and the card of a Diesel engine.

Three Photos for Our Photo Phans

New and unusual views of three well known wartime planes that are printed in response to our readers' requests. Hope you'll like them.

Side view of the Nieuport sesqui-plane Model 17.

And here we have the barrel-nosed Salmson—a light bomber.



The Pomilio is a noted Italian wartime plane.

Our Atmospheric Blanket

by
JOHN B. RATHBUN
Managing editor of POPULAR AVIATION

Lieut. Commander Settle (right) and Major Chester L. Fordney, just after their 1933 stratospheric flight.

WHILE the science of meteorology is now seriously regarded, it has not always been so. It will probably be somewhat of a shock to many modern students of the atmosphere to know that the very word "meteorology" is derived from an ancient Greek word originated by Socrates, meaning, "silly babblings about sublime things."

And perhaps many of us who have been caught in a heavy shower after the Weather Bureau has predicted "fair and warmer" have been of the same mind as Socrates. But, while it is true that meteorology cannot be listed among the so-called exact sciences, yet it is making rapid progress due to the intensive study and the use of greatly improved instruments for measuring atmospheric variations.

In the eleventh century, Arabian mathematicians estimated the height of the atmosphere at 55 miles by calculations based on the "twilight arch," or the sky illumination after sunset. But the first actual physical measurements were made by Torricelli, 1646, who proved with a mercury filled tube that the atmosphere exerts a pressure capable of supporting a column of mercury 760 millimeters high at sea-level. This instrument, then known as "Torricelli's tube," was the basis for the present day barometer.

Had Torricelli weighed the supported mercury column, and then divided this weight by the weight of a cubic foot of air, he would have arrived at an atmospheric depth of 48 miles which is quite close to the estimates of the Arabians. Torricelli's experiment was supplemented by that of Pascal, 1648, who discovered that the atmospheric pressure decreases with an increased altitude, and that the mercury tube afforded a means, thereby, of measuring elevations. Otto von Guericke, 1650, by means of his newly invented air-pump, proved that air had weight. He was also the first to predict the approach of storms by the variations in the height of the mercury column caused by the varying atmospheric pressures attending storms.

But a considerable period of time passed before the students discovered that air was not a simple uniform gas but was in reality, a mixture of different gases. Lavoisier was the first to separate pure oxygen from the air, and he also was the first to discover that air carried appreciable amounts of water vapor or moisture. Finally, Cavendish, 1784, proved that air consisted approximately of four-fifths nitrogen and one-fifth oxygen. More than 100 years later, it was demonstrated that there were also very small quantities of inert gases in addition to the nitrogen and oxygen, such as argon, helium, neon, krypton, xenon and niton. But for his time, Cavendish came remarkably close to the true analysis which now is accepted as:

Nitrogen	78.03
Oxygen	20.99
Argon	0.94
Carbon dioxide	0.03
Hydrogen	0.01
Neon	0.0015
Helium	0.00015
Niton	0.00009

Explorations into the upper air were made at an early date by means of balloons and kites. Dr. Jeffries, 1784, an American, employed Blanchard's balloon to carry with him a barometer, thermometer, electrometer, hygrometer and gas bottles to a considerable height. His data for the decrease of temperature with altitude were very close to the present accepted figures. Then followed many experiments with kites, the Hargraves box-kite being the best known. The greatest height attained by the kites was the record established at Mt. Weather, Va., of 23,800 feet.

Further developments in "Ballons Sonde," or "sounding ballons," led to very much greater altitudes. The balloon Cirrus, carrying instruments, reached an altitude of 65,000 feet in 1895. At this height, a temperature of —67° C. was observed. This record was broken in 1910 by a sounding balloon sent up from Avalon, Calif., to an altitude of 107,690 feet or 19.58 miles. The lowest temperature recorded by any balloon was —133° F. at a height of about 56,000 feet near Batavia, Java.

It is notable in all of these balloon soundings that the lowest temperature was not recorded at the greatest altitude but at the beginning of a band ranging from 50,000 to 60,000 feet. Above these altitudes, the thermometer rose slowly but steadily or stood still.

By various methods of calculation, the thickness of the atmosphere varies between 50 miles and 200 miles, but it is likely that the former value is nearest the truth. However, estimates based upon the light received from meteors or "shooting stars," when they first contact the earth's atmosphere, show

Here's Larry Lesh as he would look in the glare of the stratosphere.

and its Interesting Habits

ALL aircraft are supported by the atmosphere, hence the study of the atmosphere and its vagaries is one of the greatest and most important matters connected with aviation. The study of the text in connection with the pictorial chart will throw much light on the variations that take place at different altitudes.

the possibility of a greater height of gas ranging from 90 to 120 miles.

But—much depends upon what we actually know or understand as constituting the atmosphere. As before explained, air is not a uniform homogeneous simple gas, but is built up of several gases that are of decidedly different densities. It is therefore evident, since the air is simply a mechanical mixture of these gases, that the heavier gases will "settle out" of combination and lie closer to the earth than the lighter gases.

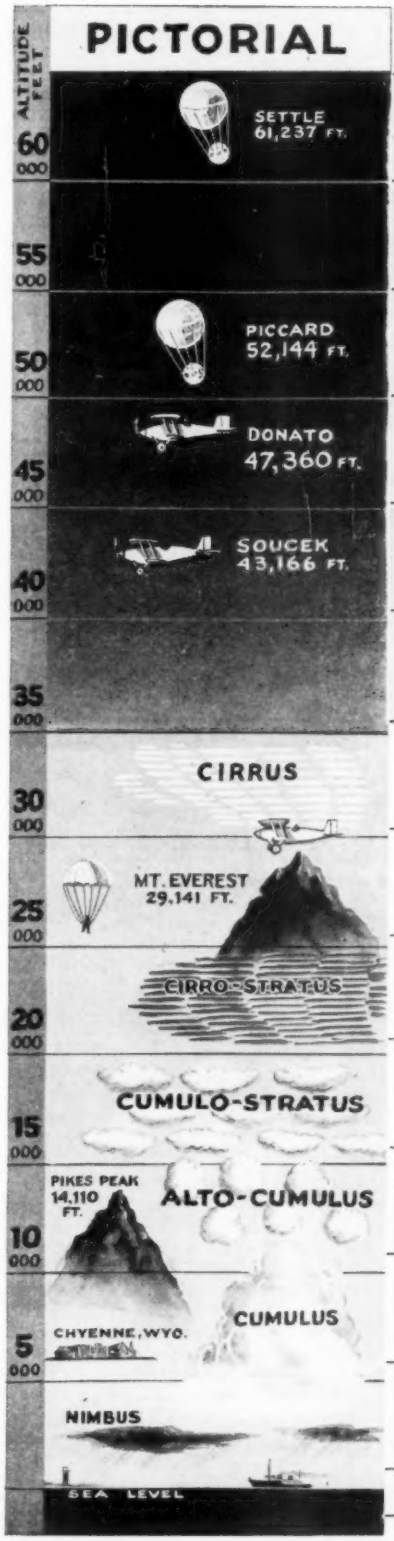
The light gases (hydrogen and helium) of course, will tend to rise high above the heavier oxygen and nitrogen and will thus indicate a higher and thicker atmosphere than would be indicated by the analysis of true air lying close to sea-level. If the atmosphere were simply air, as we know it on the earth, the total height of the atmosphere would be only 42,000 feet. If the atmosphere were composed alone of the various pure gases found in the air, we would have the following atmospheric depths.

Carbon dioxide	15,600 feet
Oxygen	21,800 feet
Nitrogen	26,800 feet
Hydrogen	350,000 feet
Homogeneous air	42,000 feet

But this is indicated more clearly by changes in the distribution of the gases at various altitudes as given in the following table. In this table, the oxygen, nitrogen and hydrogen percentages are indicated at the various altitudes, it being assumed (as shown by measurement) that moisture ceases to exist at or above 33,000 feet.

Altitude	*Oxygen*	*Nitrogen*	*Hydrogen*
Sea-level	20.99%	78.03%	0.01%
50,000 feet	19.97%	79.05%	0.01%
99,000 feet	14.64%	84.38%	0.01%
155,000 feet	14.10%	85.88%	0.05%
215,000 feet	4.24%	55.59%	39.20%
330,000 feet	00.00%	00.00%	100.00%

Thus, we see that, at least theoretically, the atmosphere is pure hydrogen at an altitude above 60 miles but, of course, the density is very low. With a barometric pressure of 760 millimeters of mercury at sea-level, the pressure at 60 miles would be only 0.0067 millimeter. Even with the best supercharger known, it would then be impossible to collect enough oxygen to ignite the charges in a gasoline engine



PRESS INCHES MERCURY	PRESS M.M MERCURY	WATER BOILS F°	NORMAL AIR TEMP.	AIR DENSITY RATIO	ENGINE OUTPUT PCT.
2.87	73.0	112.8	-67.0F	.1057	NIL
3.44	87.4	120°F	-67.0F	0.1450	NIL
			-55.0C		
4.36	110.7	128.5F	-67.0F	0.1930	NIL
			-55.0C		
5.54	140.7	137.2F	67.0°F	0.2460	NIL
			-55.0C		
7.04	178.8	146.2F	-66.2°F	0.3070	0.135
			-54.3C		
8.88	225.5	157.1°F	-49.0°F	0.3730	0.200
			-44.4C		
11.10	281.9	166.0°F	-30.2°F	0.4490	0.300
			34.5C		
13.75	349.2	174.0F	-12.4°F	0.5320	0.415
			-24.6C		
16.88	428.8	185.2F	+5.8°F	0.6290	0.540
			-14.7C		
20.58	520.7	193.6F	+23.7°F	0.7370	0.675
			-4.8°C		
24.89	631.2	202.8°F	+41°F	0.8614	0.830
			+5.1°C		
29.92	760.0	212°F	+59.0°F	1.000	100%
			+15.0°C		

because of the low percentage of oxygen in the atmosphere.

As before explained, the temperature of the atmosphere decreases consistently with an increasing altitude until a certain elevation is reached, and then at still higher altitudes, the temperature either remains constant or actually increases. This point at which the reduction of temperature ceases is variously known as the "upper inversion," the "isothermal layer" or the "stratosphere." The region below this point is called the "troposphere" which continues down to sea-level.

The average height at which the temperature inversion begins, or the distance to the stratosphere, depends both upon the latitude and the season. At the poles, the stratosphere is from five to six miles above sea-level while at the equator this may be as much as 15 to 18 miles. At the latitude of Chicago, the troposphere is approximately 10 miles above sea-level. On the equator, the temperature inversion takes place at a very much greater elevation and reaches lower degrees than in the temperate latitudes.

Lower temperature inversions are occasional temperature variations encountered mostly in winter, which seem to defy the general laws of temperature variation with altitude. These are warm layers of air overlying the colder layers near the surface of the earth.

Instead of decreasing at the rate of 1° F. for each 300 feet, as is customary, the temperature will often be found to actually increase for a limited distance during the winter months. Recently, a pilot found the earth temperature at Chicago to be 10° F. and then encountered an air blanket of 40° F. at 4,500 feet above the earth. On the same day, pilots at Cheyenne, Wyo., where the surface temperature was 8° F., found a layer of 36° F. air at an altitude of 9,000 feet.

It may be said, with fair accuracy, that the hazy thin white cirrus clouds mark the beginning of the stratosphere. Dr. van Bemmelen, who made 103 balloon ascents, concluded that the stratosphere began at a height of about 10 miles above sea-level. The reason for this difference in the rate of temperature decrease is not known definitely, but is probably due to differences in the heat radiation at certain critical atmospheric pressures.

The reduction in pressure, which is proportional to the increase in altitude, has many effects upon aircraft and physical processes. Because of the reduced pressure, water boils at a lower temperature than at sea-level and freezes at a higher temperature. The lifting capacity of balloons and airships is decreased because the density of the air is decreased.

The output of internal combustion engines is reduced unless the thinner air is pumped into the cylinders by a supercharger. The wings of airplanes lose supporting value and must be driven at higher speeds to maintain horizontal flight. But, on the other hand, the moving aircraft meets with less resistance to forward motion.

Water that boils at 212° F. at sea-level, boils at 120° F. when at an altitude of 50,000 feet, and, strange as it may seem, the water will boil at its freezing point at an altitude of 207,000 feet so that it literally boils itself into ice!

All shadows cast by the sun in the stratosphere are sharp and hard with no intermediate shading as in the troposphere. The illuminated surfaces of an object are either brilliantly illuminated or else totally dark because intermediate tones of shade are due to the diffusion caused by the air, and at such altitudes there is not sufficient air to cause noticeable diffusion.

It is also known that the atmosphere is strongly electrified, in almost direct proportion to the altitude. This electrification will range from 150 volts per foot of altitude to as high as 1,000 volts per foot during thunderstorms.

Showing the distribution of the various gaseous elements contained in the atmosphere. Note that hydrogen forms the outer strata.

The average is, perhaps, about 300 volts per foot in fine weather.

But, of the greatest interest are the clouds—masses of water vapor, water droplets or fine ice particles, depending upon their altitude. At low levels, the clouds are dark or gray by reflected light and red by transmitted light. High up in elevations below or near the freezing point, the fine ice particles show a dazzling white due to the highly reflective surfaces of the ice.

At the low levels will be found the nimbus rain clouds and the stratus clouds, the latter being really high fogs. Then above these clouds are the white wooly cumulus clouds of which there are several subtypes such as the fleecy alto-cumulus and strato-cumulus. The thunder-storm cloud is the cumulo-nimbus with the dark heavy nimbus cloud at the base of a towering brilliant white cumulus cloud.

At the very high altitudes are the various cirrus clouds, thin white hazy clouds in feather-like formation. Then, below the cirrus are the thin transparent cirro-stratus clouds and the orderly puffs and rolls of the cirro-cumulus—often called the "mackerel cloud." In the accompanying chart will be found the average altitude at which these various forms of clouds are found.

These clouds are formed by various air circulation systems, but in all cases, the moisture necessary for the clouds is carried up from the surface of the earth. The cumulus cloud, for example, is the result of vertical currents of moist air primarily originating in the warm air close to the earth. This warm air, being lighter than the dense cool air surrounding it, rises to very considerable altitudes, and the moisture contained in the air is first condensed and then frozen at the low temperatures prevailing at the high altitude, thus giving the high peaked dazzling white appearance of the typical cumulus cloud.

The updraught of the rising air currents has a considerable velocity, sufficient to prevent precipitation of the ice particles, and of sufficient velocity to support gliders and soaring planes beneath these clouds.

The thunder-cloud, the "cumulo-nimbus," consists of the high peaked cumulus cloud with the stratum of low black nimbus cloud at the base. The air in the vicinity of the cumulo-nimbus is exceedingly turbulent with high vertical velocities, making it unsafe for aircraft to venture within this zone. In addition to the danger from turbulence there is also the hazard of hail. Either or both of these causes will be sufficient to tear an airship or airplane to pieces.

Observation of the various classes of clouds will soon prove that the wind direction varies at different altitudes. At an altitude of 5,000 feet, for example, a high altitude wind may be blowing at right angles to the surface wind at ground level, or even in the opposite direction. This accounts for the clouds coming up against the direction of the surface wind, a very frequent occurrence. Clouds at a low level, such as the nimbus clouds, may float in an entirely different direction from the cumulus or cirrus clouds above them and at a different velocity.

The fact that the winds blow in different directions at different altitudes makes it possible for the balloonist to have a certain degree of control over the course taken by his balloon. To change his course, he simply increases or decreases his altitude until he finds a wind stratum that is moving in the required direction.

The winds are masses of air set into motion by temperature differences existing between two given points. The temperature differences in turn cause variations in atmospheric density and pressure that cause motion. It is for this reason that the barometric pressures vary day by day, even in the same location and at the same altitude.

In Chicago, for example, the barometric pressure may vary between a "low" of 28.5 inches to a "high" approaching 31.0 inches, either extreme indicating unpleasant weather if the change is rapid.

The U. S. Army Triangle 'Chute

by THOMAS L. GREGORY

This latest parachute, adopted by the U. S. Army Air Corps, is a highly developed and trustworthy life-saver. It is a tribute to its inventor, Major E. L. Hoffman, the outstanding authority on parachutes.

WITH the placement of a second tentative order for Triangle parachutes, this time for 392, the Army Air Corps has shown itself willing to further test the merits of this new and remarkable piece of equipment.

Some time ago, the first order was placed which proved altogether satisfactory at the various airdromes so that now it appears that the possibility of complete adoption of this equipment is by no means remote. For the edification of the readers, a brief resume of the merits of the newer chute over the old is presented.

Major E. L. Hoffman is the designer of this chute and it may be recalled that Major Hoffman was the recipient of the Collier Trophy presented by President Coolidge in 1927 for his part in the perfection of the then standard circular type parachute. Since that time, this "Daddy" of parachutes has devoted his entire time to the exploitation of this newer and better type parachute which takes its name from the shape the canopy assumes when deployed.

The Triangle, which Major Hoffman has made into a literal fabric glider, possesses, first of all, a steerability feature which is in itself remarkable. Serious injury due formerly to three reasons with the older equipment is now entirely eliminated because of the jumper's ability to steer the chute away from obstacles on the ground and to a favorable landing place. Oscillation, always the bug-a-boo, is entirely eliminated both by virtue of the large tail vent and the flattened shape of the canopy.

The former high rate of descent, prevailing under even ideal conditions with a circular type chute, due to its inability to fully take advantage of high lifting factors because of an improperly formed canopy, is now absent, as the new chute claims a greater lift ratio and consequent lower rate of descent than any other type of parachute.

The safety factor of 3½, based on a 300-pound man falling 180 m.p.h., is without question a marvel of aeronautical engineering. Its ability to withstand the shock of 1,000 pounds of lead dropped at 100 m.p.h., without the slightest trace of weakening, is likewise remarkable and a boon to speed pilots who may have occasion to leave their ships going at tremendous speeds. Even at these speeds, and at extremely low altitudes, openings are both rapid and consistent. The new springless pilot chute makes this assurance possible. Consequently, the new device is a chute for the fastest ship and the heaviest man as well as the lightplane flying at unusually low altitudes.

The harness, in more than one instance, is as nearly perfect as it has been the good fortune of a designer to construct. Built of two layers of 2,400-pound linen webbing, the harness is not only strong but unusually soft, pliable and comfortable. The fittings, constructed of a non-magnetic metal, open with a slight quarter-inch push and a quarter turn. These replace the older horse-type buckles used on other chutes which are almost impossible to unsnap in water or before landing in a high wind. There is also a conspicuous absence of the old ripcord housing, as the later type is secured directly to the front of the pack, where it is always accessible.

U. S. Army Air Corps Photo

This remarkable photo of a Triangle chute in action displays the constructional features very clearly.

Another type of chute in production by the company is the "Quick Attachable" type, which is just that. The pack is apart from the harness, being placed on the cabin wall or some other convenient place. The harness may be worn under a jacket out of the way until ready for use. Then the pack is inserted by the placement of a fitting requiring simply a quarter turn of the pack.

Probably one of the greatest difficulties to overcome in the design of a parachute, and one that has not been overcome in present day chutes with the exception of the Triangle chute, is the tendency toward oscillation. This is not only annoying to the jumper but is an absolute hazard as might easily be understood. Hemi-spherical chutes are all subject to this trouble as there is no unsymmetrical surface with which to damp out the swing.

Spinning belongs to the same category as oscillation and is still another source of danger to the jumper that has been largely eliminated in the Triangle design. To spin dizzily around at a high speed makes landings very difficult and is therefore a menace to the pilot.

Then, with a hemi-spherical chute, it is difficult to "spill air" effectively when attempting to steer the chute, but with the Triangle type, the three corners lend themselves very handily to this operation, as experiments have shown. When air is spilled with the Triangle chute, the chute effectively becomes a glider over which the operator has complete control, thus very greatly improving the accuracy of spotting a landing.

An Introductory Study in

by

ALEXANDER KLEMIN

Professor of Aeronautical Engineering, New York University.

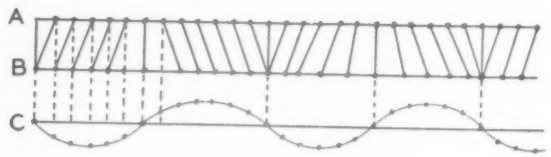


Fig. 1. Schematic diagram of a sound wave traveling through air.

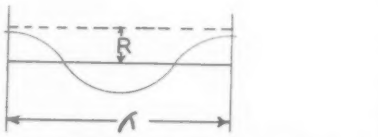


Fig. 1a. A single wavelength of a cycle of a sound wave and its amplitude.

IF air is set into vibration by some mechanical means, waves are made to travel in all directions and it is the perception of these waves by the ear which we term "sound."

It is therefore important to secure visualization of a wave. In Fig. 1 is shown a row of little masses joined by a weightless elastic cord as in line A. If a wave is made to travel along the cord, the masses do not travel in any definite direction but swing to and fro from their position of rest. A typical instantaneous position of the masses is shown along line B for a wave traveling from left to right.

At certain point along the line B, the masses have come closer together and there is a region of "compression." At other points along the line B, the small masses have spread apart and there is a region of rarefaction. The wave is constituted by the travel along the cord of these conditions of compression and rarefaction.

On the bottom line C, the displacements of the masses have been plotted in a somewhat arbitrary fashion. Displacement of a particle to the right is indicated by plotting above the line C, while the displacement of a particle to the left is shown by plotting below the line C.

The shape of the displacement curve is that of a simple harmonic motion, and a similar displacement curve would be obtained by plotting the motion of the projection P of a crank pin (rotating steadily) on the line A B of Fig. 2. With the crank at C, 90° to the line O B, the point P would be at the origin O. As the crank swings further away from O B the point P would travel towards A.

When the crank pin reached the point A, the point P would have reached its maximum displacement R. Then as the pin moved from A to D, the point P would swing back toward O. If n is the angular velocity in radians per second of the crank pin, then starting from time $t = o$, the angle $= \theta$.

Since there are 2Π radians in a circle, the time required by the crank to make a complete revolution $=$

$$\frac{2\Pi}{w}$$

and therefore the number of revolutions or cycles per second $=$

$$\frac{2\Pi}{w} = \frac{w}{2\Pi} = n.$$

The angular velocity divided by 2Π therefore gives the "frequency" of the simple harmonic motion. Also the time required for one revolution $=$

$$\frac{1}{n}$$

seconds.

There is a close analogy between the simple harmonic motion and the motion in the wave of Fig. 2. The particles have a maximum displacement or amplitude R. The distance between one crest and the next is the wave length λ, and if it takes the wave

$$\frac{1}{n}$$

seconds to propagate from crest to crest the frequency is n per second. The velocity of the wave is evidently

$\lambda n =$ (wave length) (frequency).

Studying the diagram on line C a little closer, we can conclude that at the point a the central particle will be at its position of rest, but at maximum pressure with particles on either side crowded closely together. At C the particles will have their maximum displacement from C and hence C will be a region of minimum pressure at this particular instant.

A picture of a sound wave in air can also be obtained by examining Fig. 3. Here we have shown a very long tube; with a piston at one end vibrating back and forth with simple harmonic motion. We assume that the air is partly visible, so that the small variations in pressure and density can be detected.

When the piston moves into the tube, from left to right, the air particles adjoining it will be compressed and displaced from left to right, gaining velocity from left to right. This compression wave will travel along the tube. When the piston moves from right to left, the particles will still have some velocity to the right, there will be a species of "over-shooting the mark," and a rarefaction will occur at the point where there was previously a compression. Hence the sound waves will travel along the tube as a series of compressions and rarefactions.

We have spoken of waves as if they were always plane and all the particles travelled in one direction. As a matter of fact, sound waves are spherical and starting from a given source travel along the radii of a sphere as shown in Fig. 4. Owing to the vibrating source, the waves still travel as regions of compression and rarefaction, but these waves travel in all directions. However, when considering the impact of waves on an absorbing surface, at some distance from the source, we can in practice consider the sound waves as plane waves.

THE INVERSE SQUARE LAW

IT is an interesting fact that the intensity of a noise varies inversely as

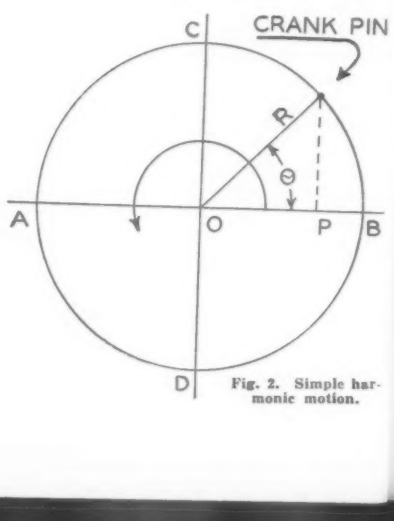


Fig. 2. Simple harmonic motion.

in the Science of Soundproofing

SCIENTIFIC study of acoustics, the cause and transmission of sound, has proved one of the most important present day subjects in commercial aviation and airplane design.

Following closely upon these investigations, comes the science of soundproofing which has contributed much to the comfort of modern passenger air-transport. If it were not for the modern soundproofing applied to commercial passenger planes, the modern Air-Pullman would not be possible.

This is the first article in a series in which Prof. Klemin gives useful information on this subject.

the square of the distance from the source of the noise (or at least approximately so).

If a source of noise projecting sound in every direction is surrounded by a spherical surface, the energy of the sound must pass through the area of the sphere and the intensity of the noise must be inversely proportional to the area of the sphere. But the area of the sphere is $4\Pi r^2$ where r is its radius. Hence the intensity of the noise is inversely proportional to the square of the radius—which radius is the distance from the source of sound.

THE VELOCITY OF SOUND

IT can be shown that the velocity of sound is given by the formula

$$v = \sqrt{\frac{E}{\rho}}$$

where E, the volume elasticity, is a measure of the force required to reduce the volume of the material by a fixed amount and ρ is the density.

A stiff spring under high pressure will, if displaced, return quickly to its position of equilibrium. If the spring has a heavy mass attached to it, its motion will be slower. Analogy with the spring explains, although it does not prove, the formula for sound velocity.

The greater the elasticity or stiffness of the material the higher the velocity; high density or mass per unit volume militates against high sound velocity. The speed of sound in air is much lower than in metals, because its elasticity is so much lower relative to its density. The following brief table illustrates these ideas:

Substance	Velocity in feet per second	
Air	1092	
Lead	4050	(heavy, low elasticity)
Aluminum	16800	(light, relatively high elasticity)

The velocity of a sound wave should not be confused with the velocity of a vibrating particle in the medium. The maximum displacement of a particle in a sound wave is a minute fraction of a millimeter. Hence even if a particle is vibrating to and fro several thousand times a second, its velocity will only be a small fraction of millimeter per second.

The velocity, $v = \lambda n =$ (wave length $\times$ frequency. In a given medium the velocity of the sound wave is constant and independent of the frequency. Hence:

1. High frequency is equivalent to a short wave length.
2. Low frequency is equivalent to a long wave length.

REFLECTION AT A PLANE SURFACE

THE reflection of sound at a plane surface is best explained by the introduction of an "image." In Fig. 5, if O is the sound source in presence of a rigid plane wall P A, then there can be no vibration across the wall at the point P. If O P is the direction of travel of a wave, and a similar wave proceeds from O^1 in the direction O^1 P, then there will be no vibration across the plane P A even if the rigid boundary is removed.

Reflection from a plane wall can therefore be simulated by placing an "image", an equivalent imaginary sound source O^1, behind the wall and symmetrically disposed relative to the real sound source O.

ABSORPTION

BY the absorption of sound, we mean the conversion of acoustical energy into heat energy. If fluid is made to flow into a number of small channels, its kinetic energy will be transformed into heat by the action of viscosity or friction.

Similarly, if sound is led into small channels, viscosity will damp out the vibrations. If the material is soft and fibrous there will be a further damping due to the microscopic displacements of the material. These simple considerations explain the sound absorbing properties of a carpet or a rug.

Absorption of sound by materials covering the walls of a room should not be with transmission absorption, where sound is absorbed in passing through a wall or partition. We shall discuss transmission absorption later on.

ABSORPTION COEFFICIENTS

IN the noise-proofing of airplanes it is not only important to impede the transmission of sound into the cabin, but also important to absorb in the covering of the interior walls such sound as has already penetrated into the cabin. Therefore, we must define the

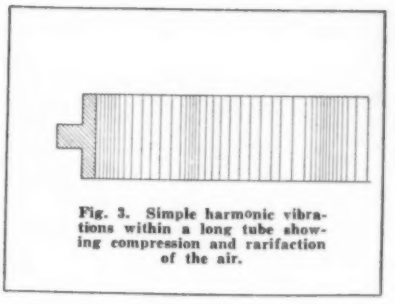


Fig. 3. Simple harmonic vibrations within a long tube showing compression and rarifaction of the air.

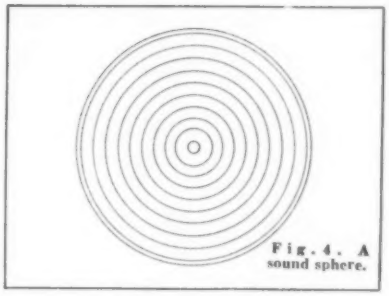


Fig. 4. A sound sphere.

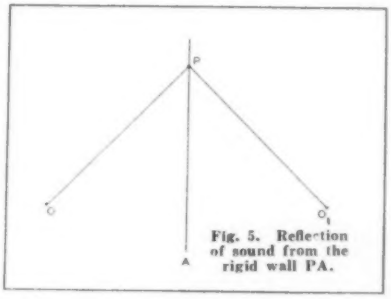


Fig. 5. Reflection of sound from the rigid wall PA.

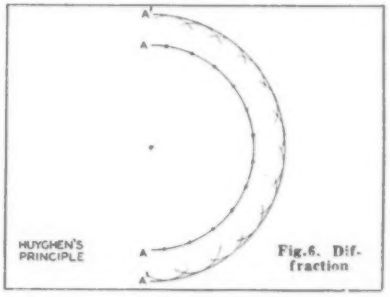


Fig. 6. Diffraction

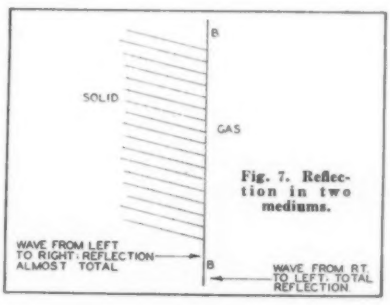


Fig. 7. Reflection in two mediums.

absorption coefficient and know its values for certain typical materials.

If sound within a room passes through an open window, very little is reflected back and it is practically all absorbed, that is, it never returns. The coefficient of absorption of a given material is defined as the ratio of its absorption per square foot to the absorption of a square foot of window space under the same sound emission conditions.

REVERBERATION IN A ROOM

WHEN a source of sound is placed in a room, there is continual reflection from the walls and the magnitude of the sound is greater than if there were no walls and no reflection. When the sound emission ceases, the absorption power of the walls is more strongly in evidence, and after a certain time the sound becomes inaudible.

The repeated reflection of sound in a room is called "reverberation." The "time of reverberation" is the time required for the sound to become inaudible. After the sound emission has ceased, the "time of reverberation" will depend on the size of the room and on its absorption power.

The larger the room, the fewer will be the number of reflections per second from the walls and the less the rate of absorption. It is clear also that the more absorbent the material of the walls, the shorter the time of reverberation. Hence

$$t \text{ is proportional to } \frac{\text{Volume of Room}}{\text{Absorption Power}}$$

In the airplane cabin, the effects of reflection are important in a somewhat different way. Suppose that a cabin is well sound-proofed so that relatively little sound is admitted. Let us suppose further that the walls, although well protected against sound transmission, have no interior covering of absorbent material. In such a case, even though little sound is introduced, its level will be gradually built up by reflection from the walls until the intensity inside the cabin is equal to that outside. This building up of sound intensity will evidently be more marked in a small cabin than in a large one. The importance of interior absorption is quite clear.

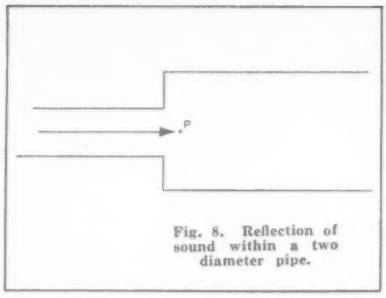


Fig. 8. Reflection of sound within a two diameter pipe.

SOUND WILL GO ROUND A CORNER

IT is not necessary to see the source of sound in order to hear—sound will go round a corner. When a change of direction sound propagation is caused by the introduction of an obstacle the sound is bent or "diffracted" round the object.

The explanation of "diffraction" lies in the wonderful Huyghens' Principle which is illustrated by Fig. 6. Here, a circular wave-front passes from the semi-circle a a to the semi-circle a′ a′. If, with centers on a a, a number of smaller semi-circles are drawn with radii equal to the distance between the wave fronts, the envelope of the small semi-circles will trace out the wave front a′ a′.

The above is not a rigorous, but a sufficient proof of the Huyghens' Principle that a spherical wave front may be replaced by a series of hemi-spherical sound sources. In other words, we may consider that sound is propagated up to a certain point by a spherical wave and that its further propagation can be studied by introducing a series of sound producing hemispheres.

If the sound waves meet an obstacle, the hemispheres will evidently "shoot" sound waves round the corner. Of course, the intensity at a point will be lessened by the introduction of a plane obstacle immediately ahead of it—but there will be no clearly defined shadow or region of no waves (as in the case of light waves).

The diffraction about the head of a speaker is a classical study. There is found a "maximum of intensity" (that is an intensity greater than at all neighboring points) immediately in front of the speaker, also one immediately behind the speaker.

PASSAGE FROM ONE MEDIUM TO ANOTHER

IN Fig. 7 are shown a solid and a gas with a plane surface of separation between them. The problem arises as to what occurs when a sound wave passes across the boundary.

Suppose the wave is coming from right to left. The pressures in the light gas must be small, and since the inertia of the solid is so much greater than that of the gas, only the most minute vibrations are communicated to the solid. There is practically total reflection of the sound wave.

If the wave is coming from left to right, the amplitudes of vibration at the boundary are the same in the solid as in the gas. But the energy in a sound wave is dependent not only on the amplitude but also on the density of the substance. Therefore, only a minute fraction of the energy of the sound wave can be transmitted from solid to gas, and there is almost total reflection.

TRANSMISSION ABSORPTION

WHEN sound waves in a medium encounter a second medium with a different elasticity, part of the energy is thrown back in the form of reflected waves, part is absorbed in the second medium and part is transmitted. The amount reflected depends on the ratio of the "acoustic" resistance of the two substances.

The acoustic resistance (which is roughly analogous to electrical resistance) is proportional to the density of a medium times the velocity i.e. ρv. The velocity of sound in the medium is v and since

$$v = \sqrt{\frac{E}{\rho}},$$

the acoustic resistance is proportional to $\sqrt{\rho E}$. In general, more sound will be reflected where the ratio of the acoustic resistances is large. This statement is in agreement with the considerations of the previous paragraphs.

Where more than two media or materials are involved, there will be reflection of sound at each change of medium. The amount reflected at each boundary will still depend on the ratio of the acoustical resistances.

A rough rule for the construction of a panel to reflect as much noise as possible is to use a multiple material panel with the individual elements of widely varying densities and elasticities.

In designing sound proof partitions, not only reflection is considered but also

(*Continued on page* 124)

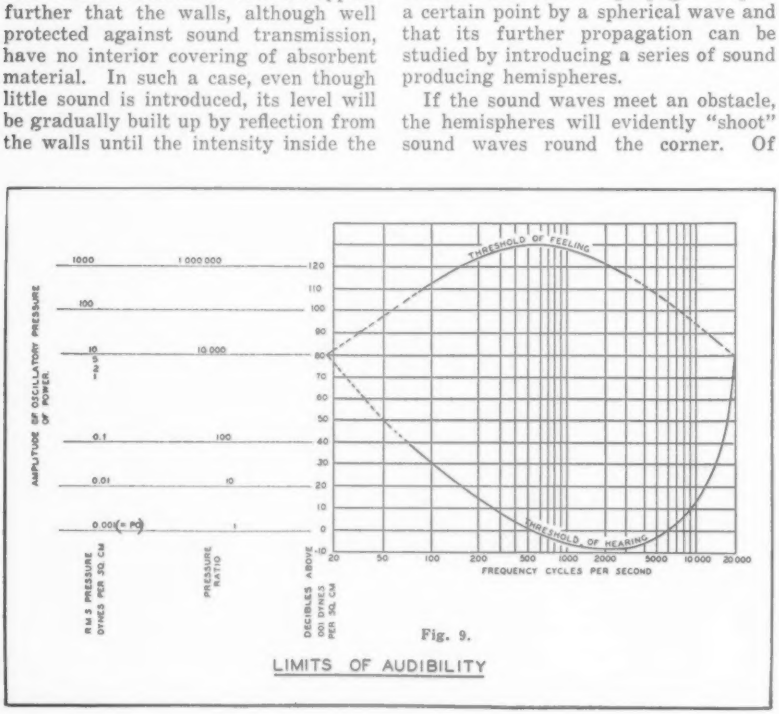


Fig. 9.

LIMITS OF AUDIBILITY

The Rapier "H" Type Engine

A description of an exceedingly interesting aviation engine recently developed by a famous English automobile and aviation engine manufacturer. It very greatly decreases the presented frontal area of the plane.

A NEW engine of strikingly original design has recently been put into production by the well known English firm, D. Napier & Son, Acton, London, W.3., England. This is the "Rapier" series, a 16-cylinder "H" type air-cooled engine made in two ratings.

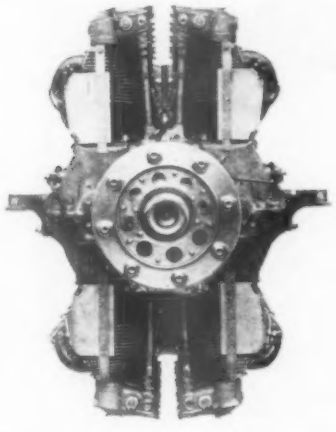
While they are of the same general design and dimensions, the two Rapier models are built in two outputs. First, the Series II for military planes and the Series IV for commercial planes. Both engines are of the sixteen cylinder air-cooled type, with the cylinders arranged in four banks of four cylinders per bank. Two of the banks are vertical and two are inverted. By virtue of this arrangement, it is claimed, the presented frontal area is less than half that of a comparable engine of the conventional radial type with a corresponding reduction in the head-resistance.

Both engines have a bore and stroke of 3½ in. by 3½ in. and both are geared down with a reduction ratio of 1 to 2.5625. The compression ratio of both types is 6.00.

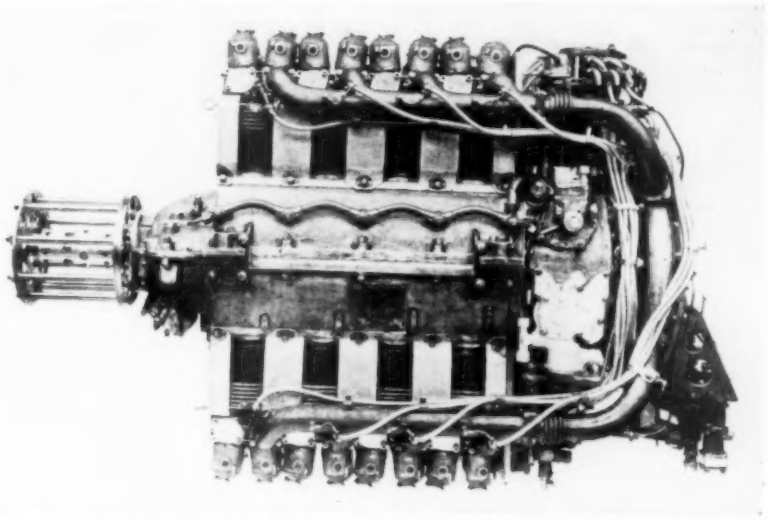
The Series II military type has an International rating of 295/306 b.h.p. at 10,000 feet, turning at 3,500 r.p.m. Its maximum output at the same altitude is 340/355 h.p. at 3,900 r.p.m. crankshaft speed. The propeller turns at 1,522 r.p.m., maximum speed.

The Series IV engine has an International rating of 325/340 b.h.p. at 10,000 feet altitude while turning at 3,500 crankshaft r.p.m. The maximum output is reached at a crankshaft speed of 3,900 r.p.m. at which it shows 370/385 h.p.

Two crankshafts are provided, one for the left-hand and one for the right-hand blocks. In short, the engine can be considered as being built up of two 2-cylinder opposed engines, back-to-back, with all cylinders in a vertical plane. Two pinions on the ends of the crankshaft engage with the propeller-shaft gear, much after the arrangement of the wartime Bugatti engine. The propeller shaft is carried by two bearings and the gears are of the case-hardened steel type. This arrangement should give excellent running balance.



Front elevation of the Rapier Engine showing small frontal area.



Side elevation of the 16-cylinder "Rapier" engine in which four blocks of four cylinders each are placed in the vertical plane. Two crankshafts are geared to the propeller shafts.

A very interesting connecting-rod arrangement has been developed. All of the connecting rods in the upper cylinders (port side) are master-rods provided with caps for the connection of the pivoted auxiliary rods. This is reversed on the starboard side where the master rods are in the lower cylinders and the auxiliary rods are at the top. The big ends have separate steel bearing shells lined with lead-bronze while the wrist pins are bushed with phosphor-bronze. Each of the two crankshafts are carried in six plain bearings.

The cylinders are made from steel forgings, machined all over, and are provided with screwed-on aluminum cylinder heads. These heads carry the inlet and exhaust passages, the valves and valve actuating mechanism. It will be noted from the photograph that suitable baffle plates are arranged on the cylinders for controlling the flow of cooling air about them so that an equitable distribution of air is maintained, both fore and aft.

A glance at the front view of the engine will show the very small amount of frontal area presented by this type of engine—this area being the equivalent of only four cylinders and therefore less than half the area with a radial type. Furthermore, this permits of a much better arrangement of the fuselage nose than with a radial engine with a still further reduction in the parasitic losses. As a matter of fact, this engine is as compact and "lean" as a liquid-cooled engine and should lend itself admirably to improvements in the front end construction of airplanes.

An aluminum crankcase, divided into halves, encloses the engine parts and the propeller reduction gearing. A separate timing-gear case carries the camshaft-gears and the gearing for driving the auxiliaries such as the magnetos, oil pump, etc. The oil sump is attached to the underside of the timing-gear case and contains the scavenge oil pumps, the pressure oil pump and the oil filters for the pressure pumps.

Ignition is provided by two 8-cylinder magnetos, mounted at the rear of the engine with the magneto spindles in a vertical position. Special distributors are installed to facilitate hand-starting when hand-starting is necessary. The magnetos are of the 2-point type for dual ignition.

A Special Napier Claudel-Hobsom carbureter, bolted direct to the rear of the supercharger, is provided with an oil jacket for heating. An altitude control cock, interconnected with the throttle control, gives the necessary control under all conditions of supercharger boost. At the rear, the supercharger of the centrifugal fan type is connected between the carbureter and the inlet manifolds. The supercharger is driven

from an extension of the propeller shaft through layshafts by means of special spur-gears. Friction disc clutches are incorporated within the layshafts.

For lubrication, two suction-pumps and one pressure-pump are provided. The suction-pumps scavenge the oil sump and return the oil to the supply tank while the pressure-pump takes oil from the sump and delivers the oil to the working parts under pressure. An oil filter is placed between the pressure-pump and the engine and two filters are provided for the suction-pumps.

Hand-starting is provided by means of a special system for assisting the carburetion and ignition. Gasoline is injected into the intake manifold by means of a hand-pump and is ignited in the cylinder by a hand-starting magneto operated through the distributers of the engine magnetos. A gas distributer is installed to provide an alternative system of starting by an auxiliary engine and gas-compressor. A hand-turning gear provides an 8.28 to 1 ratio between the hand-crank and crankshaft.

Based on maximum speed, the bare weight of the Series II engine (without accessories), is 2:0 pounds per b.h.p. The weight of the Series IV is slightly higher under the same conditions, 2.14 pounds per b.h.p. The fuel consumptions are respectively 0.616 and 0.0604 pounds of gasoline per b.h.p. hour with a fuel having a specific gravity of 0.755.

Another point that is of great importance to an aircraft engine is the matter of smooth and vibrationless running with an engine of the Rapier type. Considering the engine, as previously suggested, as a pair of 8-cylinder opposed engines placed back-to-back, it is possible to cancel out any phase of unbalance that may exist in either of the two units, and the unbalance of an 8-cylinder opposed engine is practically negligible within itself.

All conditions of both explosion balance and dynamic running balance should be satisfied with such an arrangement, and with sixteen cylinders, the flow of power should be particularly smooth. This, of course, reduces propeller stresses and intra-revolution pauses that ultimately affect the application of power to the air.

In respect to military service, it will be remembered by old-timers, that the propeller shaft of the Bugatti engine was bored to a large diameter so that a machine gun or small cannon could be fired through the propeller shaft without the complication and uncertainties of gun synchronized gears. Whether this has been applied to the Rapier is unknown at present, but this is just one more possibility of this type.

Rapier engines have been filtered into several types of planes and various new planes are being designed for them. The "H" type of engine, although not strictly new, should go a long way toward higher efficiency.

END.

Details of the Armstrong-Whitworth Fighter

THERE are two English single-seat fighters that have attracted the attention of our readers, the A.W. XVI single-seat Fleet Fighter and the A.W. 18 fighter, the latter being a direct descendant of the well known "Siskin."

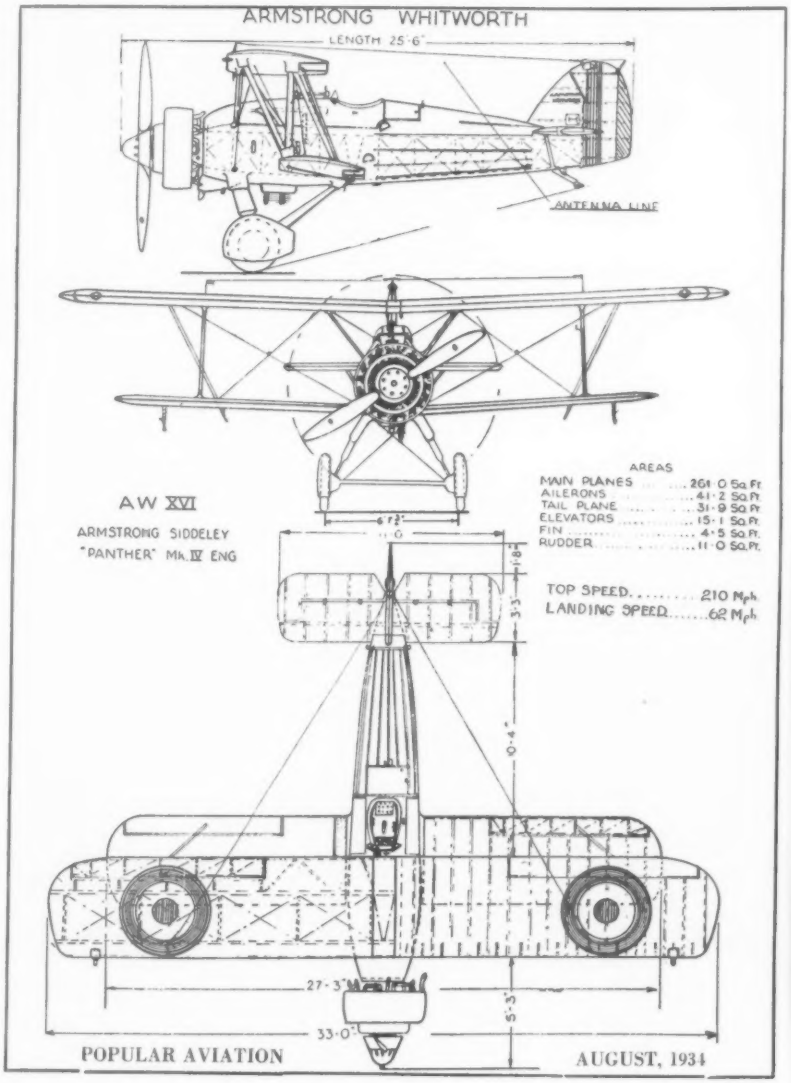
The Armstrong-Whitworth A.W. XVI is powered with a 500 h.p. Armstrong-Siddeley "Panther" engine. It is of all-metal construction and has been carefully streamlined after much experimental work in the wind-tunnels. It has a span of 33 ft. 0 in. and weighs, with full military load, 3,900 pounds. The engine cowling has been carried out in a typical British manner.

It is provided with sufficient fuel for two hours' flying. The top speed is said to be 210 m.p.h. with a landing speed of about 62 m.p.h.

The Siskin, well known in Canada, is the progenitor of the A.W. 16. This ship, very similar to the above, is also provided with a 500 h.p. Armstrong-Siddeley engine. In spite of what has happened to it in the way of altered details, it is still a biplane with the usual British accentuated dihedral in the wings.

The Armstrong-Siddeley Mark IV. "Panther" engine is carried within the conventional English type anti-drag ring with the exhausts arranged radially about the ring. Below the fuselage will be seen the oil-cooler and storage tank for the engine oil. A "Vee" type radio antenna extends from the wings to the tail in a manner that would indicate considerable wind resistance.

The front elevation shows that much thought has been spent on the arrangement of the interplane bracing which is particularly well arranged from a structural standpoint.



Army Formations in Shorthand

by ARTHUR PRATHER

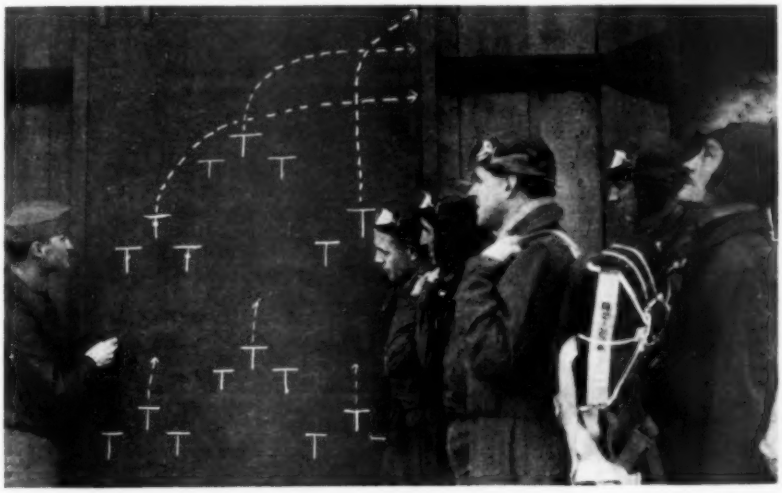
U. S. Army Air Corps Squadrons flying in formation, are governed by rigidly drawn plans just as the construction of a building is regulated by the blue-prints. Here, we see how the maneuvers are laid out, illustrated by official photographs supplied by the U. S. Army Air Corps.

IN the sky, high above the Army Air Base, a squadron of wasp-like pursuit planes dived and zoomed. In perfect formation, they thundered across the field at two miles a minute or more.

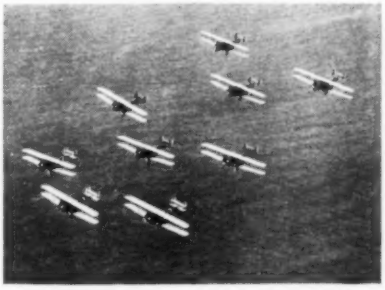
In a steep climbing turn at the end of the field, changing formation as they went, they banked their tiny fighters around and glided into the field. A few minutes later, the twenty-seven pilots were grouped in front of the blackboard for the "critique" which follows every air corps training maneuver.

White chalk in the hands of the operations officer traced strange hieroglyphics on the blackboard, illustrating point after point concerning the flight just finished. These symbols and diagrams form a short-hand system which is as valuable and as clear to the military pilot as Gregg or Pitman is to a stenographer. Not an invention of a single individual, this weird picture writing is being developed day by day in pilots' rooms and operations offices on every military flying field in the country.

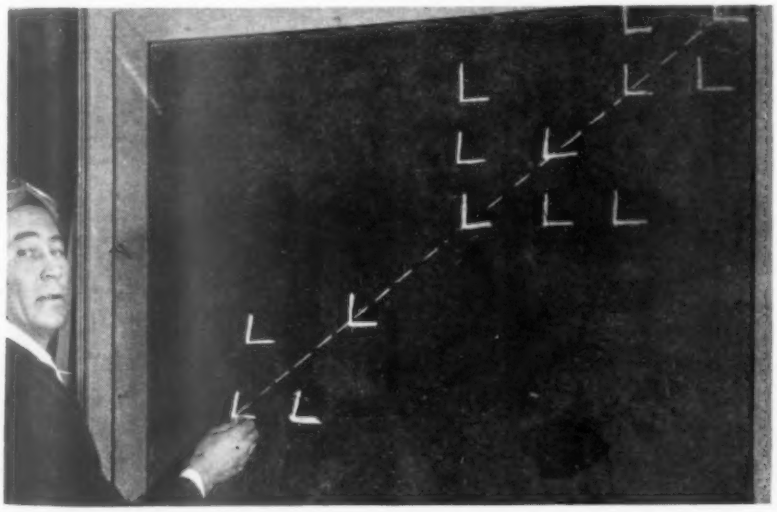
Although no set rules govern it, and each instructor has many symbols of his own invention, this system of shorthand is readily understood by any Army pilot and with only slight difficulty by the civilian layman. The reason for this is that it is a system of true hieroglyphics in which the symbols are true ideographs. That is, each one represents a particular object or an idea associated with that object.



A "critique" or "post-mortem" held after a formation flight in which the Operations officer points out errors to the army pilots.



And here they go, on a practice flight in formation flying.



Each of the "angles" represents an "element" of three planes while the dotted line represents the course of the flight.

Some of these symbols are as old as airplanes themselves, but because of their ideographic origin, their meaning is easily seen. Such a symbol is the "T" used to designate a single airplane as seen from above.

Originally, a complete outline of the airplane in plain view, line after line, was eliminated until now the symbol of a "T" with the cross on the end which represents the front of the plane is the standard representation for a single ship. This convention is so well established that every airport has a "T" on the ground to show the direction of landing.

Pilots see more in this than a weathervane indicating the direction of the wind. To the experienced airman, the stem of this "T" represents the fuselage of an airplane, the cross represents its wings. Thus, it symbolizes an airplane on the ground headed into the direction he must land.

Another aerial sign, which is almost as widely used and as well known as the "T," is the symbol used to represent a sideview of the plane. A straight line, with a shorter curved line above it, may represent an airplane. The longer line represents the fuselage, the shorter one, the upper wing. But this symbol is highly adaptable.

The short curved line above the straight one represents a high-wing monoplane, but if it is below the straight line, the ship is a low-wing monoplane. Two curved lines, one above and one below the straight line, mean a biplane.

Instructors sometimes add wheels,

the propeller and even tail surfaces to these diagrams, making them approach closely to a picture of the plane which they represent.

The front view of the airplane is usually represented by a small circle with one or more straight lines. A horizontal line above the circle represents a high-wing monoplane, while if it is below the circle, the ship is a low-wing monoplane. Both lines together, one above and one below, the circle, indicate a biplane.

The propeller is usually represented by a long, skinny figure eight in the position occupied by the motor. Thus, a single engined plane would have an "eight" centered on the circle representing the fuselage, while a twin or tri-motored plane would have additional eights in the appropriate positions.

Although these symbols for individual planes are sufficient for small formations, other symbols are required to represent whole units in different situations when larger organizations, such as the squadron, the group, or the wing, are employed.

A pursuit squadron now contains, besides the commanding officer's plane, twenty-seven ships divided into three "flights" of nine planes each. Each flight is further divided into three elements of three planes each.

"A separate symbol must be used to represent an element, another for a flight and still another for a whole squadron," says the operations officer of the 479th Pursuit Squadron, Reserve, of Long Beach, California, "because, when combined with other tactical units of the same size, each of these units is completely self contained and the planes of which it is composed are mutually dependent.

"The three planes of an element always act as a single plane. Therefore, the element must be represented by a symbol appropriate to the type of formation in which it is flying. Thus, an element of three ships in "V" for-

(*Concluded on page* 118)

Flying in echelon, an army flight maneuver.

The Aero-Sportswoman

by JOAN THOMAS

Here are the "Kiwiettes," the members of the girls' aviation club formed at the Calumet High-school, Chicago, Ill.

OUR invitation to visiting flyers to call on the Aero-Sportswomen for assistance while visiting the 1934 Century of Progress is going to be the source of a heap of fun this summer if we can judge by the first request.

At three o'clock Saturday afternoon, May 26, just one hour after the Exposition was officially open, Phoebe Omlie rang us up and wanted to know if we could help her contact Gracie Allen, the Zazu Pitts of radioland!

Of course, the personnel of an information bureau, lost and found department, or a Traveler's Aid should not be surprised at any request. But after a very unprofessional laugh, we asked Mrs. Omlie if she was one of Gracie's admirers. "Yes, indeed," she said, "I always tune in on her programs. I have never met her and I think it might be very interesting. I would like to take her over to the Federal Building at the Fair and show her the Department of Commerce's aviation exhibit."

We asked if Gracie was a flyer, Phoebe didn't know but thought she might be a prospective one at least, after an hour or so experimenting with the Department of Commerce's fascinating models of wind tunnels, miniature planes, etc.

Miss Allen and her husband, George Burns, were featured performers in the opening day ceremonies at the Century of Progress, but that part of the program had been completed before we got Phoebe's message. And sad to relate, though we searched diligently among the 155,999 celebrating visitors that first gala evening, they managed to escape the dragnet, and by the time we found the trail again they had departed for New York.

Phoebe's next request was to help her locate an experimental plane that she had heard about, which by the way, was the official reason for her coming to Chicago at this time. So on the following Monday, we conducted her out to the Curtiss-Reynolds airport to inspect Steve Nemeth's round-wing ship, which had been dubbed the "flying waffle" by local pilots. A description of it may be found in the June issue of POPULAR AVIATION, so we won't bore you with a second-hand account.

The thing we wish we did know—is how much of Phoebe's conversation that afternoon was "off the record." We haven't had as much fun in a month of Sundays; Phoebe told hilarious tales about Mrs. Roosevelt, Lon Yancey, Amelia Earhart and various other notables, and like other people who have a keen sense of humor, the funniest story of all was one on herself.

(We are like the girl reporter who attended one of Mrs. Roosevelt's regular press conferences, she had such a good time she forgot to take notes and then didn't dare write the story afterward, because she couldn't remember which part was "off the record.")

* * *

"THE WINGS OF A CENTURY," which portrays the stirring drama of Transportation at the Century of Progress—from the lumbering ox-carts to that latest marvel of the rails, the Burlington's 117 m.p.h. "Zephyr"; from the birch-bark canoe to those lordly liners of the air—challenges the imagination.

And we who have been privileged to see the beginnings of air transportation are wise if we do not try to prophesy its future. For the youngsters of today, to whom the World War is merely a lesson in the history books, are looking toward aviation as a possible career as naturally as they might consider any other field of science or business.

An interesting example of how this new field is attracting girls as well as boys, may be found in the Calumet Highschool in Chicago. A group of 150 junior and senior girls have formed a club known as the "Kiwiettes," which meets at least once a week for lectures on aeronautical subjects.

Mr. Arthur J. LaPointe, Jr., who is an instructor in aeronautics at Calumet, has given the girls a course in Air Commerce rules and regulations, lectures on the airways, beacons, emergency fields, air mail and the army.

The Katzmayr Effect Explained

by J. D. VAN VLIET

One of the most interesting and strangest of aerodynamic phenomena is the Katzmayr effect by which negative drag can be produced under suitable air conditions. The author, long experienced in flight phenomena, discusses this matter in an understanding manner.

VARIOUS explanations have been offered with reference to the rather extraordinary efficiency of the flexible wing described in the September issue of this magazine, Katzmayr effect having been repeatedly mentioned as a likely reason for the high lift drag ratio.

Although the Katzmayr phenomenon merits full consideration as a likely factor which may under certain conditions contribute to the aerodynamic efficiency of an airfoil, it can as yet not be accepted as an authentic explanation.

Our knowledge of Katzmayr effect is still very elementary, the study of this fascinating subject having not been consistently followed up nor deemed worthy of extensive investigation since the early initial wind tunnel experiments.

Examining such slender data as is at present at our disposal, we quote from the original report by Katzmayr, which appeared in *"Zeitschrift für Flugtechnik und Motor Luftschiffahrt,"* March 31 and April 13, 1922 (translated in *N.A.C.A. Technical Memorandum* 147, Oct. 1922), as follows: "Both from theoretical considerations and the observations of bird flight, we have learned that soaring flight is possible only when an airfoil can draw energy from the surrounding air; also that this can best be accomplished in gusty weather."

It is gratifying to note the candid reference to bird flight by an eminent authority on aerodynamics, which rather implies that a systematic investigation of soaring flight may eventually furnish the clue to *economical* mechanical flight.

The purpose of Katzmayr's investigation was to determine the effect produced by an oscillating air-stream on the aerodynamic characteristics of an airfoil. To this end a series of experiments were conducted on an airfoil fixedly mounted in a wind-tunnel, the entering throat of which was provided with a grating of horizontally placed slats jointly pivotable about their respective length axes whereby the direction of the air stream could be periodically changed from a positive to a negative angle.

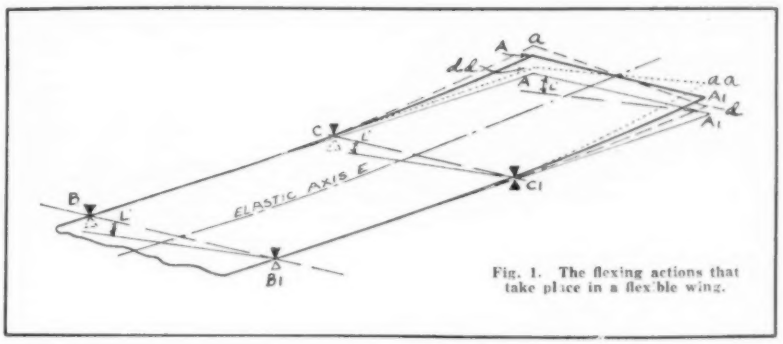


Fig. 1. The flexing actions that take place in a flexible wing.

The carefully plotted readings showed that there was a considerable reduction in drag, combined with a very slight reduction in lift attendant to the periodic change in the vertical direction of the air current, the lift reduction, however, being not sufficient to appreciably affect the generally increased lift-drag ratio.

With a thick wing section a negative drag could be repeatedly measured, corresponding therefore to a forward ascending lift. The tests on various airfoil models all showed that with an increasing magnitude of the amplitude of oscillation of the air stream the aerodynamic constants of the airfoil continued to improve. It was further found that there was a well-marked limit to this improvement, since after a certain amplitude of oscillation was exceeded, varying from $\pm 9°$ to $\pm 12°$, an increase in drag was recorded attended by a further reduction in lift.

It was established that the number of oscillations per minute was of little importance in one airfoil, while in another airfoil a decrease in the number of oscillations showed a somewhat greater lift, but also a greater drag. These phenomena occurred at a relatively small angle of deflection of the air stream and held good for a frequency as high as 30 oscillations per minute. Hence a period of two seconds for a complete oscillation sufficed to effect a considerable improvement in the aerodynamic qualities of the wing.

It was definitely shown that wing sections which exhibit favorable characteristics in a constant air flow work still better in an oscillating current. It was also shown that wing sections characterized by a high drag coefficient were more susceptible to drag reduction than others which had a normally low drag coefficient.

Now it would be logical to assume that if the wind current were kept flowing in a constant direction, with the airfoil oscillating about a transverse axis, this reversal of the conditions would not affect the results since the *relative* deviation of the air stream with reference to the airfoil would remain the same as in the previous case. A series of tests carried out for the purpose of investigating and confirming this assumption however, brought out the astonishing fact that, instead of improving the aerodynamic qualities of the airfoil, they were thereby decidedly adversely affected.

It is this possibility of obtaining effortless flight that has attracted all technical minds to the Katzmayr effect and yet, at least so far, the theory and windtunnel tests give no encouragement so far as an oscillating wing is concerned. It is to be hoped that more progress will be made along this line for the general good of aviation. Whether deflecting vanes or electrostatic devices will be used for stimulating undulation in advance of the plane are now simply conjectures. But the stumbling block proves as follows:

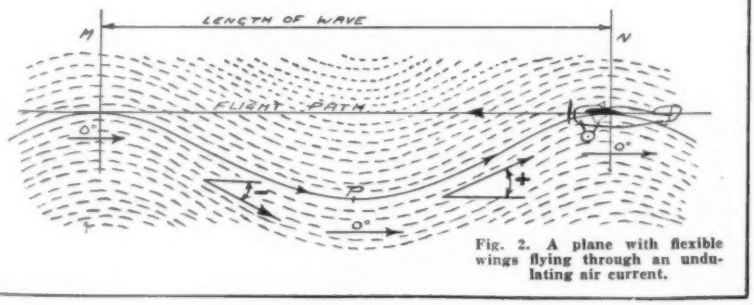


Fig. 2. A plane with flexible wings flying through an undulating air current.

Katzmayr's report states succinctly: *"With a wind blowing in a constant direction no improvement of the aerodynamic properties of an airfoil can be obtained by causing the airfoil to oscillate about an axis lying within its perimeter parallel to its front and rear edges."*

In view of the careful way in which the experiments and readings were conducted, there seems to be no room left for arguments to the contrary, the less so since Katzmayr's results were subsequently independently confirmed by Toussaint, Kermis and Girault in France, as reported in N.A.C.A. Technical Note No. 202. A satisfactory reason for the disappointing behavior of an oscillating airfoil in a steady air stream has thus far not been given by any of the above investigators.

The N.A.C.A. T. M. 147 report closes with the remark: "The Katzmayr effect is so far of academic interest only, but it would become of real and practical significance if periodic variations in the vertical direction of natural wind could be shown to exist, especially, if means were available whereby the aircraft pilot could detect them. The inertia of the airplane would act as the fixed support in the wind tunnel to preserve the original flight path direction and the effective axis of lift and drag, if the frequency of the pulsations were high enough."

A very acceptable exposition of Katzmayr effect is given by Shatsweil Ober, M. I. T. in the N.A.C.A. Technical Note 214, February, 1925, in which this author offers some simple mathematical formulae in fair agreement with the results of his own wind tunnel investigations. From his analysis it appears that the reduction in drag-coefficient varies approximately as the square of the amplitude of oscillation of the air stream.

He points out that when the frequency of the oscillation is such that the wing chord is only a small fraction of a wave length, the angle of attack may be considered constant along the chord at any instant during the oscillation, and the lift and drag improvements can then be calculated from values made in a steady wind. If the wave is so short that it approaches the length of the wing chord, the above assumption cannot be made and the calculation becomes invalid. The changing direction of the stream, like the induced drag on an airfoil of low aspect ratio then acts to change the effective curvature of the wing section.

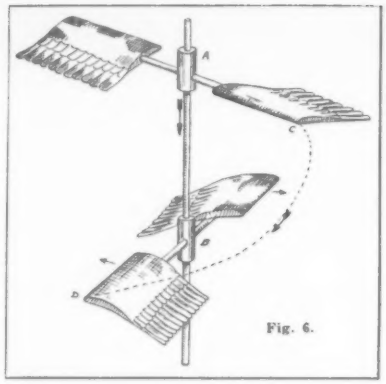


Fig. 6.

He further states that by using the mathematical analysis, the reduction drag for a good wing due to an oscillation of 1° amplitude is 5.2% and that due to ½° is 1.3%. It is certainly not inconceivable that there may be an oscillation in wind direction of ½° at some windspeed in almost any type of tunnel. The fact that this oscillation may change with the windspeed would offer an explanation of the strikingly different characteristics, shown by "scale effect" curves, taken in different tunnels.

All the above-named investigators, then, acknowledge the existence of a Katzmayr effect caused by an oscillating air current on a steady airfoil. There is nothing in the experiments discussed that would refute the assumption that Katzmayr effect which occurs on an airfoil which is held stationary while the oscillating air stream advances against it will also occur on an airfoil which advances at a constant angle of incidence into an oscillating air current, from which it may be inferred that Katzmayr effect is present in real airplanes at almost any time during flight.

The experiments also seem to have demonstrated conclusively that no such effect can be obtained by oscillating the wings of a plane while maintaining a steady flight path. Even so, we are not convinced that such would be the case in actual flight.

The vertical deviations of the air currents in nature can be considered as being constantly present, for, except on very rare occasions when the air is perfectly still, the billowing, undulating action of clouds and smoke are plainly discernible. The wind near the surface of earth or sea is always more or less turbulent, while at higher altitudes these turbulences are smoothed out into undulations. It is also possible that the length of these undulations increases with altitude.

Those who have watched the gradual dispersal of "sky-writing" at high altitudes will readily admit the existence of undulating air currents at a height of many thousand feet. And furthermore the existence of such oscillating or undulating currents has been attested by all those who have gone aloft and ridden the "bumps."

The variations in the intensity of the wind pressure and vertical direction of the air currents could be plainly observed fom the cockpit of the flexible-wing plane mentioned above. The wing was seen to yield periodically to the increased wind pressures while the flexible trailing edge was raised and lowered at intervals independently from the helicoidal "washing-in" and "washing-out" of the wing as a whole. This "working" of the wing was particularly noticeable in gusty weather, the deflections of the flexible trailing edge amounting at times to an inch or more, while the "wash-out" at the wing tip would sometimes approach a deflection of three or four inches.

The lateral flexure of the wing was practically constant, probably because the variations in the aggregate wing-load and in its distribution were not of sufficient magnitude to lower the wire spars from the upper sills of the secondary supports. These supports were adjusted for a contact ratio of 1:8, that is to say, it took one-eighth of the normal wing load to flex the spars so that they would engage with the secondary supports. On rare occasions however, a sudden downward gust would bring a spar momentarily in contact with the lower sill of its secondary support, so that the wing would then flex slightly downward, without however disturbing the lateral balance of the plane.

Since the wing structure was especially designed to absorb and wash-out the shocks imparted to it by the turbulent air currents, the progress of the

(*Continued on page* 122)

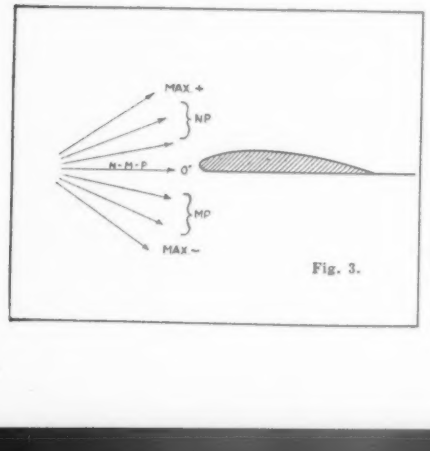


Fig. 3.

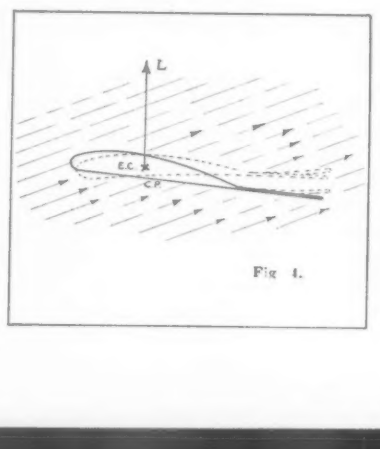


Fig. 4.

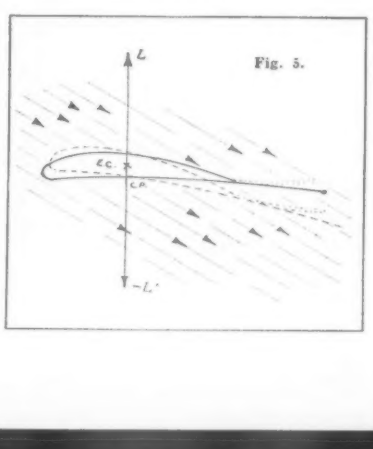


Fig. 5.

Gas Taxes Threaten Aviation

by KEITH J. FANSHIER

If the present trend in gasoline taxation continues, commercial aviation is threatened with extinction. It will be literally taxed out of existence. All the aviation industry should unite in strangling this tax demon before it developes further.

THE long hand of the tax-collector is reaching farther and farther into the air. Aviators used to think, with a sense of relief when they took off, that they were leaving the cares and troubles of a material world behind.

But the government these days is in everything—everything that will yield revenue. As a result, there is a distinct trend now that will put a new burden on aviation, whether commercial or amateur. It comes in the form of a new tax. Those interested in the welfare of aviation are already arousing to fight the tendency. Others who have not already sensed the situation could well afford to join the cause.

The new tax is not really new. It is the tax on gasoline. But there is a new application of it—an application of the gasoline tax to aircraft.

The gasoline tax originally was conceived by a brilliant Oregon state legislator who thought he saw an opportunity to add a "painless" means of additional tax collecting. A gasoline tax of 1 cent was inaugurated in that state in 1919—fifteen years ago. The idea went across with a bang. Inside of ten years not only had every state in the Union taken up the idea, but the amounts of the levies had increased amazingly until the rates ran anywhere from 2 cents to a top of 7 cents per gallon (Florida and Tennessee).

On top of that, the federal government began to grow uneasy because here was a new and green field being hogged by the states. The result was a 1 cent federal gasoline tax, entirely separate from, and additional to, all state levies. This became a 1½ cent tax a little later, although now it is back at 1 cent. Efforts to eliminate entirely the 1 cent federal tax failed in the closing weeks of the recent session of Congress.

Although Oregon started something which has since turned into a great abuse through the excesses to which it has been subjected, it must be admitted that the heart of the Oregon originator was in the right place. The first plan was to have proceeds from the tax go to the construction and maintenance of roads. This principle was adhered to for some time.

However, later the states began to observe that various pet projects requiring money in their states were not getting enough of it, and that it was easy to collect the gasoline tax. Why not divert proceeds from the gas tax and use at least some of them for purposes other than roads? The users of gasoline, they figured, were an easy lot and wouldn't object.

As a matter of fact, that is exactly the way the thing worked out. The first plan was to collect a moderate amount from those who used roads and to spend the collections for building and improving those roads. Fair enough. But when this modification of principal came into vogue, gasoline tax moneys began to be diverted to all kinds of peculiar uses. First it was state educational funds, then sea-wall maintenance funds, then state fish hatcheries funds, general funds, and what-not. Clearly this division of the gasoline tax situation was getting out of hand.

But there was another abuse. It generally was agreed that those buyers and users of gasoline who did not use roads—such as the aviation interests, for example—could hardly be taxed on the theory of supporting the roads, since they did not use the roads. All right, it was stated, such users shall be exempt from paying tax. And so it went for a time. However, there was trouble. They permitted rebates to such consumers, but it was found there were many dishonest claimers of rebates who had never been any closer to aviation than to see a plane in the sky, and these were claiming refunds.

The result was the beginning of a trend now under way in various states, to take away from aviation the right to get refunds on gasoline taxes. This practice is spreading.

If anyone in aviation wants to "get tough" about the situation and go to bat and spend a little money for legal tilts, he probably will have a good case on this count. Why should an airplane be taxed on the gasoline it consumes when it never uses the roads to which the proceeds of the gasoline tax fundamentally are presumed to go?

Or, as someone suggests, now that they are going to tax the gasoline airplanes use for the theoretical purpose of maintaining the roads, why shouldn't aviation have the right to work the rule in reverse?

Why, in other words, shouldn't aviation have the right to use these selfsame roads? There's a thought which probably would make some of these peculiarly-constituted legislators get hopping mad and start raving over the constitutional prerogatives of their constituents, whatever that means.

But as a matter of fact, it is just as logical for airplanes to use roads for landing or taking off or parking or servicing — especially under circumstances of emergency—as it is for the tax collectors to grab moneys from aviation for road purposes, or for any other ordinary uses attaching to the surface of the globe ordinarily used by the competitors of the airplanes. That was a long sentence, but it has its points.

If a plane runs out of gas within the bounds of the states of Tennessee or Florida, and if the pilot takes on 100 gallons to get him to his destination, he is going to have to pay $8 of the total amount for gasoline tax. In many other states he would have to pay totals almost as large. And bear in mind that the rate of 8 cents a gallon is just about three times the value of the gallon of original crude petroleum from which the gasoline was made—that's a tax burden to think about!

Last year there was collected from

GASOLINE TAXES BY STATES

State	Rate Cents per Gallon (Exclusive of 1 cent federal tax)
Alabama	6
Arizona	5
Arkansas	6½
California	3
Colorado	5
Connecticut	2
Delaware	3
District of Columbia	2
Florida	7
Georgia	6
Idaho	5
Illinois	3
Indiana	4
Iowa	3
Kansas	3
Kentucky	5
Louisiana	5
Maine	4
Maryland	4
Massachusetts	3
Michigan	3
Minnesota	3
Mississippi	6
Missouri	2
Montana	5
Nebraska	4
Nevada	4
New Hampshire	4
New Jersey	3
New Mexico	5
New York	3
North Carolina	6
North Dakota	3
Ohio	4
Oklahoma	4
Oregon	5
Pennsylvania	3
Rhode Island	2
South Carolina	6
South Dakota	4
Tennessee	7
Texas	4
Utah	4
Vermont	4
Virginia	5
Washington	5
West Virginia	4
Wisconsin	4
Wyoming	4

gasoline taxes for the country as a whole a total of $518,000,000. Remember, however, that this was state taxes only. In addition, the federal tax yielded enough to boost the total of federal and state collections up to within hailing distance of the stupendous figure of $700,000,000. The average tax rate is more than 5½ cents a gallon including the federal tax.

It is stated that the experiences of the last year have proved that the best and cheapest way for states to derive more revenue from taxes upon gasoline is to enforce the law and to assure complete collections, rather than to increase tax rates. At one time, a few years ago, it looked like the respective states were engaged in a race to see which should reach a rate of 10 cents a gallon first. However, the fact became borne home to legislators that they were killing the goose that laid the golden egg and they began to moderate in these activities.

Higher tax rates, according to those who have made a thorough study of the question, invariably encourage tax evasion and aggravate the already serious situation created by the policy of levying sales taxes at rates as high as 33⅓ percent. to 100 percent., or even more, of the retail price. Last year the cumulative federal and state gasoline tax rate throughout the country averaged 43.59 percent. of the average retail price of gasoline, a rate so high as to make complete collection and thorough law enforcement virtually impossible at any cost.

The experience of 1933, it is stated, should prove also that low taxes, fully collected, are as remunerative, if not more so, than high taxes. This is especially true in the case of taxes on gasoline and with evasion so easily possible. Low tax rates not only discourage evasion, but encourage consumption. In either case the state gains revenue.

It might be stated that there is a move under way to reduce taxes. Success of this movement is in some doubt as it is like pulling eye teeth to deprive politicians of their revenue sources. However, enough noise now has been made to prove that the tax rates should not be increased indefinitely, and that it is felt is a distinct gain.

Aviation interests will be interested in the following statement which shows that there are in addition to the current 1 cent federal gasoline tax, a total of seven different rates of gasoline tax rates in the various states. In the attached list it is necessary to add 1 cent for federal tax and it should be remembered that in Alabama, Louisiana, Missouri, Mississippi, New Mexico and Florida, there are, in many districts, additional city or county taxes or both (so much so that in some cases the much-discussed total of ten cents in gasoline taxes is virtually a reality).

It will be noted that as a general rule there is a distinct trend toward higher rates of gasoline taxation in the south. As a rule the southern states pile it on more than the northern states. There are various reasons for this, but it is a fact worth remembering for anyone consuming or connected with a concern which consumes large quantities of gasoline in various parts of the country.

So far, the aviation industry has been comparatively free from the inroads of taxing bodies but, largely for the present prosperity of the airlines, this will not be for long. The airplane is destined to pay the road taxes that should be paid by the commercial motor-bus and motor truck fleets that, for some reason, have always been under the wings of the politicians.

And when vehicles, such as the airplane, are taxed on the basis of the amount of fuel and the cost of fuel, used, it will be just too bad for such vehicles.

In conclusion, it might be pointed out that it would be well for friends of aviation to ally themselves with those interests, both in and outside of the petroleum industry, who have become alarmed at and have been combating the tendency to increase rates and total collections for gasoline taxation.

END

GLOSSARY OF WORDS, TERMS AND PHRASES — DIC-A-17

Air-strata. See AIR-STRATUM.

Air-stratum. A layer of air, usually assumed to lay in a horizontal plane.

Air-stream. A current of air. A continuous mass of moving air having defined dimensions.

Air-streamlined. A body so shaped that it does not break up a stream of air into eddies or discontinuous masses. Such a body passes through the air with the least possible resistance.

Air-stresses. Reactionary forces produced within a body of air that resist the deformation of the air or changes in volume.

Air-tempering. A type of steel that can be tempered in still air. Usually an alloy steel.

Air-thermometer. A thermometer in which the expansion and contraction of air is used for indicating temperature. It consists of a glass tube, closed at one end, with the open end immersed in a liquid. Variations in temperature proportionately vary the volume of air and the height of the liquid indicates the temperature. Very accurate.

Air-turbine. An air-engine in which a jet of air impacts upon paddles or teeth arranged on the circumference of a wheel.

Air-turbulence. Air in a commotion comprising eddies, swirls and other irregular and indeterminate motions.

Air-velocity. The linear speed of an air-stream, usually quoted in feet per second, feet per minute or miles per hour. In the metric system, the common unit is meters per second.

Air-viscosity. The internal resistance or friction of the air molecules which resist motion or a change of form. Numerically, it is represented by the force necessary to shear through a given area, the force usually being given in dynes.

Air-vortex. A rotating or whirling column of air having a reduced pressure at the center. Tornadoes are of this type.

Airway. (1) A route or definite path followed by scheduled aircraft. (2) A company or corporation operating scheduled air transportation.

GLOSSARY OF WORDS, TERMS AND PHRASES — DIC-A-18

Air-wheel. (1) A wheel fitted with vanes for moving air or for being moved by an air-stream. (2) A rotary movement of the atmosphere as in a cyclone or anticyclone.

Airworthy. Aircraft or devices fit for service in the air.

Aisle. (1) A long narrow passage, usually down the center of a given space. (2) The passageway in a cabin plane.

Aitken Dust-counter. A meteorological instrument for determining the amount of dust or solid matter in the atmosphere, the dust being collected, removed and weighed.

Aitken Koniscope. A dust measuring instrument by which the percentage of dust in the air is found by the color that it gives to the atmosphere.

Akkumulator (German). Storage battery.

Ala. A winglike part.

Alar. Winglike.

Alated. Winged or provided with wings.

Albatross (also Albatros). A seabird of the petrel family (Diomedea Exulans) noted for its remarkable soaring ability. It inhabits the southern Atlantic and the entire Pacific ocean.

Alcohol. A white clear volatile liquid obtained by the distillation of fermented sugars. There are many kinds of alcohol, the principal commercial types being ethyl alcohol, methyl alcohol and amyl alcohol.

Alclad. Sheet aluminum alloy employed for covering or surfacing aircraft wings, cabins, fuselage, etc.

Alcohol (Absolute). Alcohol in its pure state and free from water.

Alcohol Engine. (1) An engine of the steam engine type in which alcohol is used instead of water for generating pressure. (2) An internal combustion engine adapted for the use of alcohol fuel.

The "Knight-Twister" Flies

by VERNON W. PAYNE

P.A. feels a great interest in the performance of this vest-pocket pursuit ship because it is the outcome of a conference with Mr. Payne in our office and the original drawings were first published by us. Our faith in Mr. Payne and his design has been justified.

IF anyone tells you that there is a keen looking little airplane at the airport, and you should see it, first ask them if it is a Knight Twister. If it is, you will not be disappointed.

It is not only keen looking but it is really small. Standing under the wing of a Stinson Monoplane it looks like a toy, but don't let that fool you, for it means business when it is ready for flight.

At last we have exploded two time-worn theories, which are: (1) That a small biplane could never be built as stable or as efficient as a monoplane. (2) That small planes are tricky.

This little vest-pocket pursuit type of biplane has a top wing span of 15 feet, a lower wing span of 13 feet and an overall length of 11½ feet, so you see that one important point in our favor of biplanes is the small housing space required.

The old criticism that small planes are tricky to fly, dates back to the World War when not so much was known about the proper location of the wings in relation to the center of gravity of the airplane. Many of these old-timers forget that aviation has advanced considerably since the war. We have many better wing sections that have been developed since the war.

We selected the N. A. C. A.-M6 wing section which is fairly fast but inherently stable. This means that when the ship dives, the center of pressure on the wings, moves forward and tends to bring the ship out of the dive. When the ship is stalled, the center of pressure moves back, tending to lift the trailing edge of the wing up, thereby bringing the ship out of the stall. This all helps to make a small ship a smooth flyer.

Many small ships were built with the RAF15 wing section, which has a great center of pressure movement which is hard for the average amateur to balance properly, therefore the result is a very unstable and tricky flying ship. Oftentimes these ships would pancake when the pilot tried to bring it in slow and found that the lift suddenly turned up missing. The RAF15 landed fast and lost its lift quickly near the stalled position.

Here's Vernon W. Payne standing beside his latest product—the celebrated "Knight-Twister." The efficiency of this little ship has been proved.

The M-6 wing section, which we use, can be stalled at a much greater angle of attack than the RAF15. This high angle of attack, when coming in for a three-point landing, helps to slow down the air pressure on the elevators and will force the tail skid into the ground, which acts like a dragging brake.

Well, fellows you should have seen this little ship perform. It is a honey in the air as well as on the ground. Let me tell you, if you want a picture see the ship immediately after making contact with the ground.

The biplane wings of this little ship, with the high amount of stagger, act as a large wet blanket. This is much the same as an air brake, deflecting the passing air sharply towards the ground. When the wings are close to the ground, the air is compressed, and this is what shortens the roll of the ship after landing.

Another thing that can be used to shorten the roll after landing, is the large tail surface. The Knight Twister has large elevators and if the stick is pulled back after making the landing, and when it is flying, you had better get a telescope, for it doesn't hang around. It gets right out of sight.

We took a snap-shot of the ship after it took off, but there was only a fly-speck on the picture. The only pictures of value that are available were taken on the ground. We will get someone with a long distance movie camera to get the next action pictures and these will appear in an early issue of P. A.

The first trial flight was made with a propeller borrowed from a Klemm low-wing ship. This propeller, manufactured by Gardner Propeller Works, Chicago, was designed to fly a Klemm at 65 m.p.h. But it did better than we expected, for this flat angled propeller flew the Knight Twister at 100 m.p.h. This means that the light biplane has so little resistance that the propeller tried to run away with itself so that the engine turned up much too fast.

The Gardner brothers have successfully designed propellers for this ship for high speed and also for service. One propeller for racing at 150 m.p.h. The other is the service propeller which gives a better climb rate, or smaller take-off run, and a top speed of 135

Towing the "Knight-Twister" to the field. It is hardly larger than the small car but is infinitely faster.

m.p.h. with the Salmson A.D.9 engine.

Many of you have heard a Salmson engine when it was flying a Klemn low-wing and noticed that sort of whispering exhaust. It did not convince you of much power. Well, fellows, wait till you hear it in the nose of the Knight Twister for it has a powerful hum like a real pursuit ship.

To see this little ship pass you, bank and turn, dive, pull up and perform many maneuvers, makes you wish that you could get in and get hold of those controls for yourself.

The first landing was made very close to me, and being the first time a pilot ever flew this ship, he naturally flew it in hot—about 80 m.p.h. When he was close to the ground he tried for a three-point and, believe it or not, when the ship contacted with the ground, it appeared to stop right instantly. Even with the fast landing, I'll bet it did not run 175 feet. The pilot, "Curley" Cushman, made several flights and found that the ship will make a perfect 3-point at 40 m.p.h. and not roll over 125 feet. You can therefore get into a very small field.

Both pilots, "Curley" Cushman and Fred Buchardt, claim this little ship to be the most stable little plane ever built. It was flown on a very windy day and it flew "hands-off." The Knight Twister does not bob up and down in a breeze. It is not treacherous to fly, like so many of the little ships The extra large tail and aileron control that were built for the last few races.

The first flight tests were made with no engine N. A. C. A. cowl ring or surfaces will bring it out of any spin or stunt.
wheel pants, so you can imagine what the great increase in speed will be with these fairings in place.

We intend to design a two-place having the same general proportions as the Knight Twister, but a little larger. The span will be about 25 feet and the overall length about 17 feet. The landing speed will be 30 to 35 m.p.h. and the top speed about 100 m.p.h., using 50 to 65 h.p.

We have changed the tail a little, making the rudder larger for easier taxying control. We also made the stabilizer and elevators larger to enable the pilot to get the tail off quicker, when taking off with a speed propeller that does not throw back enough blast for good control at take-off speeds. A climbing propeller will get the tail up very well.

In the original drawings of the Knight Twister we showed a stabilizer and elevators made of steel tubing, but the tail we actually used was made of spruce and plywood. The ailerons were also made of spruce and plywood instead of steel tubing.

The wings are of the cantilever type, spruce and plywood construction. We use one flying-wire to brace the wings, but the wings are strong enough to stand a crash landing while doing a complete cart-wheel without breaking a spar—believe it or not. In spite of their strength, the dead weight is only 1.1 lbs. per sq. ft. area.

The fuselage is of steel tubing, faired to a perfect elliptical cross-section, with spruce strips and plywood rings.

The landing gear, made like a fork, is of No. 1025 Aircraft steel tubing. It could be made lighter if made of alloy steel and heat treated, but some mechanic would have an opportunity to make a mistake and replace alloy steel with common low carbon. The result would be a weak landing gear, ready for a crash landing.

In engineering the Knight Twister, we kept safety uppermost in mind and you will notice that where the strain is greatest, we have an ample size of tubing. This little cloud buster will take it.

In a ship of this size, where the landing-gear is proportionately much larger than with a big ship, the wheel pants and other fairings will make a tremendous difference in the top speed and general performance. As it stands now, the landing-gear kicks up a tremendous disturbance in the air and correspondingly cuts down the speed with a given horsepower.

There are a few other little "bugs" to clean out, and then we believe that we will have the fastest little craft of its size and type that has yet been designed.

END

AVIATION MATERIALS—MAT-H-60
ALUMINUM AND ALUMINUM ALLOYS

SHEET ALUMINUM. (284—12″x72″.) Available in two finishes and termed "half-hard" in "polished" and in "dull gray." The following are the "polished" sheets commercially available. "half-hard."

12″x72″ All sizes and gauges from ½″ to 30 gauge.
24″x72″ All sizes and gauges from ¼″ to 24 gauge.
30″x60″ All sizes and gauges from ¼″ to 20 gauge.
36″x96″ Available in 16 gauge only.
36″x120″ All gauges from 14 to 22 gauge.
36″x144″ All gauges from 8 to 20 gauge.
60″x120″ Only 16 gauge commercially available.
60″x144″ Only 16 gauge commercially available.
48″x144″ All gauges from 8 to 20 gauge.
Gray finish half-hard aluminum is available only in 14 gauge.

SHEET DURAL. U. S. Army Air Corps Specifications 57-152A. 17ST Sheets 36″x120″. Dural is slightly heavier than aluminum

Gauge B & S	Decimal Inches	Wt. in Lbs. per Square Foot		
		Alum.	Dural	Alclad
1/2″	0.50000	7.040	.....	.....
3/8″	.3750	5.280	.....	.....
5/16″	.3125	4.400	.....	.....
1/4″	.2500	3.520	.....	.....
3/16″	.1875	2.640	.....	.....
8	.1285	1.810	.....	.....
10	.1019	1.440	.....	.....
12	.0808	1.140	1.18	.....
14	.0641	0.903	0.94	0.94
16	.0508	0.716	0.75	0.75
18	.0403	0.568	0.60	0.60
20	.0320	0.450	0.46	0.46
22	.0253	0.357	0.38	0.38
24	.0201	0.283	0.30	0.30
26	.0159	0.225	0.24	0.243
28	.0126	0.1789	0.24	0.183
30	.0100	0.1410	.....	0.150

ALUMINUM FOOTING OR TREAD. This material for wing-walks. The weight is the same as that of pure aluminum sheet of the same gauge.
Available in 20 gauge, four pyramids per square inch.
Available in 12″x20″ widths, cut to any length from roll.
Available in 24 gauge, same width and pattern as above.

AVIATION MATERIALS MAT-H-61
ALUMINUM AND ALUMINUM ALLOYS

WEIGHTS OF SHEET ALUMINUM, DURAL AND ALCLAD

ALCLAD (17ST) CORRUGATED SHEET ALUMINUM (DURAL)

Gauge B & S	Thickness Inch	Sheet Size Inches	Weight Sq. Ft.
20	0.0320	23¼″x120″	0.58
22	0.0253	23¼″x120″	0.43
24	0.0201	23¼″x120″	0.33
26	0.0140	23¼″x120″	0.24

DURLUMIN TUBING (17ST) ROUND. Air Corps specifications 57-187A

Size O. D.	Wall Thick.	Stub's Gauge	Weight Per Lineal Ft.
3/16	0.022	24	0.0134
1/4	0.028	22	0.0237
5/16	0.028	22	0.0299
3/8	0.028	22	0.0371
1/2	0.028	22	0.0504
7/8	0.035	20	0.1102
7/8	0.049	18	0.1514
1	0.035	20	0.1267
1	0.049	18	0.1724
1	0.065	16	0.1860
1-1/8	0.065	16	0.2020
1-1/4	0.035	20	0.1597
1-1/4	0.065	16	0.2287
1-1/2	0.049	18	0.3399
2	0.049	18	0.3605
2	0.065	16	0 4635

STREAMLINE DURALUMIN TUBING (17ST)

Largest O. D.	Wall Thick.	Stub's Gauge	Weight-Per Lineal Ft.
3.35″ x1.5″	0.065	16	0.6530
1.875″x0.375″	0.035	20	0.1709
1.389″x1.86″	0.083	14	1.0115
3.710″x1.572″	0.065	16	0.6942
3.375″x1.430″	0.650	16	0.6190

SQUARE DURALUMIN TUBING (17ST)

3/8″ x3/8″	0.022	24	0.0381
9/16″x9/16″	0.040		0.0906
3/4″ x3/4″	0.049	18	0.1751
1″x1″	0 036		0.1648

P. A.'s KONTACT KLUB KOLUMN

THIS new department serves a purpose long in demand by our readers. It is a bulletin-board by which you can contact pilots, mechanics and parachute jumpers FREE OF CHARGE. We hope that you will avail yourselves of the privilege that this department extends to you and that it will grow rapidly and become an important factor in aviation.

ED NELSON, Pilot, Chicago, Ill. I have an important message for you. Please get in touch with me (if in Chicago) by telephone.—J.R., Phone: AVENUE 2685.

K.L.B., formerly of Milwaukee, Wis., and mechanic for Al Bentley's Flying Aces in 1932. We're making good with our new aerial act, and wish you would join us. Will pay your transportation if necessary. HARRY KALER, Altamont Hotel, Chicago, Ill. (Until July 15.)

BERT ALDEN, formerly a barnstormer on the Atlantic coast. Would like to talk to you about a passenger carrying deal. Have two ships and a brand new idea that should clean up. If you don't remember my real name, I am the guy that they called "Horseface Klotz" when we were in the show at Portland. Answer quick.—JACK KOERNER, 2771 Avenue "A," Minneapolis, Minn.

J. A. INGRAHAM, pilot, formerly of Roosevelt Field. If at liberty, please join me. I have only one ship and enough prospective students for two. Let me hear from you right away.—FRED LUDLOW, 6400 Beacon St., Chicago, Ill.

BOB TRUESDALE, formerly of Washington, D. C. What did you do with that wind-tunnel project? Let me hear from you.—ALLEN JOYCE, 1333 Waverly Place, Detroit, Mich.

BILL McCORMICK. I wrote to you at Baraboo, Wis., but got no answer. If you still have that OX-5 Travel Air I think I have a good deal for you.—ORLAND FRENCH, Bay Point, Mich.

EARLY-BIRDS NOTE! I wish to get in touch with a number of the members of the Early-Birds.—HELEN S. WATERHOUSE, 25 Burton Place, Akron, Ohio.

ERIS DANIELS, girl parachute jumper. I would like to hear from you immediately. Box 13, Columbia, Tenn.

HUGH THOMPSON. Please write to me immediately. Box 13, Columbia, Tenn.

J. J. BARTHOLOMEW, formerly of South Bend. Ind. If you succeeded in getting your transport license let me hear from you at once. H.H.J., Box 521, Detroit, Mich.

AKT TROY, at one time a mechanic at Municipal Airport, Chicago. Write to me at once concerning that landing gear crackup at Cedar Rapids. Give me all the dope that you can about the condition of the tires and wheels.—E. C. EMERY, 3132 Indianapolis Blvd., Hammond, Ind.

JOE GREINER, Alta Vista, Calif. Tried to get you by letter but failed. We are going ahead with that lightplane project, so you had better get in touch with me at the earliest possible moment.—GEORGE KNOCKLES, 310 Westpoint Ave., Auburn, N. Y.

FRANK JOHNSON, somewhere in Illinois. Don't buy that 1930 Fairchild until you hear from me. There is a lien on it.—FRITZ STAUFFER, Freeport, Ill.

GERALD SCHWIMMER, where are you? I have been down in S. A. and wrote to you several times from there but got no reply. Am going to open a repair shop where there is a lot of welding for you to do. Answer quick.—LOREN WHITNEY, 1556 N. Whipple St., Orange, N. J.

L. K. J., of Tulsa, Okla. Had your ship recovered and ready for relicensing. Better come back right away and take out a new license. Bring a little cash with you.—B.R.T. Muskegon, Mich.

G. S. FARMER, formerly of Milwaukee, Wis. Draftsman. Have a set of French lightplane plans that I wish to translate. Mut get started within a month.—BILL STRUBER, Box 243, Anderson, Ind.

ANTON ZRAKA, please tell me where you stored my tools. I need them immediately.—AXEL OLSON, 2756 Avenue "C," Portland, Me.

MULLINS—I don't know your first name nor initials, but worked with you out at Fort Worth on a recovering job. Please let me hear from you.—BOB NORBERT, 56 Plymouth Pl., Youngstown, Ohio.

JACK ENGLE, formerly Chicago sandlot operator. Let me hear from you at once.—Sandy Apperson, 7217 Glenlake Ave., Cleveland, O.

JESSIE FALK, St. Louis, Mo. If not dated up please let me hear from you. We have three ships on the road trailing banners and would like to have you dual on one ship. Good money for these times.—JOE (MACK) MURPHY, Houston, Tex.

DOC EVANS, formerly with Scott's Air circus in 1931. I am using this means of paging you as I have received no reply to repeated letters addressed to Cedar Rapids, Ia. Write me and if possible, give me Dot Matthews' address.—KARL KORN, 132 Forest Glen Ave., Memphis, Tenn.

HENRY BLACKMAN. I would like to communicate with you immediately.—D. C. ACKERMANN, 24 Willow Springs Rd., Louisville, Ky.

A. FRANKEL, formerly of Willow Springs, Ill. Lost your address. If you still have that dope on hand, I will take two barrels.—H. S. J., at Compton's Garage.

AERODYNAMICS — AER-WI-52
LIFT AND DRAG COEFFICIENTS

BRITISH SYSTEM. The system devised by the British aerodynamic laboratories and used in British textbooks, is based on absolute units in a manner somewhat similar to the N.A.C.A. system. In the British system, the lift-coefficient is designated by (L_c), while the drag-coefficient is (D_c). The mass-density of the air is p, the area is (A), and the air-velocity is (V), is in feet-per-second.

Lift = $L = L_c \times p \times A \times V^2$ = pounds.

Drag = $D = D_c \times p \times A \times V^2$ = pounds.

The British coefficient is exactly half as great as the American N.A.C.A. coefficient.

GÖTTINGEN SYSTEM. The coefficients employed by the Göttingen Laboratories are based on absolute units. They are 100 times greater than our N. A. C. A. units. The lift coefficient is (Ca) while the drag coefficient is (C_w). Then: cient is (C_a) while the drag coefficient is (C_w). Then:

Lift = $C_a \times 0.01 \times A \times V^2 \times p/2$

Drag = $C_w \times 0.01 \times A \times V^2 \times p/2$

LIFT AND DRAG COEFFICIENT CONVERSION

TO FIND	MULTIPLY THE GIVEN COEFFICIENTS AS SHOWN BELOW			
	N.A.C.A. COEFF.	ENGINEERS	BRITISH COEFF.	GOTTINGEN COEFF.
K_y	$0.00256 \times C_L$		$0.00512 \times L_c$	$0.0000256 \times C_a$
C_L		$391 \times K_y$	$2 \times L_c$	$0.01 \times C_a$
K_x	$0.00256 \times C_D$		$0.00512 \times D_c$	$0.0000256 \times C_w$
C_D		$391 \times K_x$	$2 \times D_c$	$0.01 \times C_w$

EXAMPLE. To demonstrate the use of the table above, let us say that we wish to find the value of an Engineering coefficient in terms of K_y when the given value of C_L is 1.5.

$K_y = 0.00256 \times C_L = 0.00256 \times 1.5 = 0.00384$

AERODYNAMICS — AER-WI-53
CONVERSION OF COEFFICIENTS

USE OF TABLES. To simplify the conversion of the various lift and drag coefficients, the following conversion tables have been prepared. The figures are based upon the N.A.C.A. absolute system and advance by 0.005 intervals.

These tables, while not exactly applicable to all variations, are sufficiently closely intervaled for estimates, and are true for lift and drag coefficients. The values are calculated from the conversion factors on Data Sheets AER-WI-51 and AER-WI-52. If used judiciously, they will be of great assistance where many conversions are to be made and will save a great deal of work.

Let us refer to the first table on Data Sheet No. AER-WI-54. There are two parallel columns of figures beginning with the N.A.C. coefficient 0.005 and ending with the coefficient 0.390. As you will see, the N.A.C.A. coefficients on which the tables are based, are in the left-hand columns headed "N.A.C.A., C_L or C_D". To the right of these columns are columns for the other coefficients such as the Engineering Units, the Göttingen Metric Units and the British system.

Let us say, for example, that we wish to find the value of an Engineering coefficient corresponding to an N.A.C.A. unit of 0.095. Follow down the left-hand column to 0.095 and then to the next column to the right where it will be found that the corresponding engineering unit is 0.00024320. This applies to either the drag coefficient or lift coefficient, and they can be used interchangeably.

If we follow clear across the table, we see that an N.A.C. coefficient of 0.095 also corresponds to a Gottingen coefficient of 9.500 or a British coefficient of 0.0475. Now, let us turn the procedure around. Say that we have an engineering unit given amounting to 0.0003968 and that we wish to find the corresponding N.A.C.A. unit.

Follow down the column of Engineering Units in the second column until we reach the given quantity of 0.0003968. To the left will be found 0.155, the equivalent N.A.C.A. coefficient.

You will note that the numerical value of the Göttingen units is 100 times greater than the N.A.C.A. units, while the British units are one-half the value of the N.A.C.A. units.

Building the Epps Lightplane

by MANLEY MILLS

This is the first article of a series, giving full directions for the construction of a Ford motored lightplane that has given very satisfactory service. It was designed and built by an oldtimer in the game—Ben T. Epps, Athens, Ga.

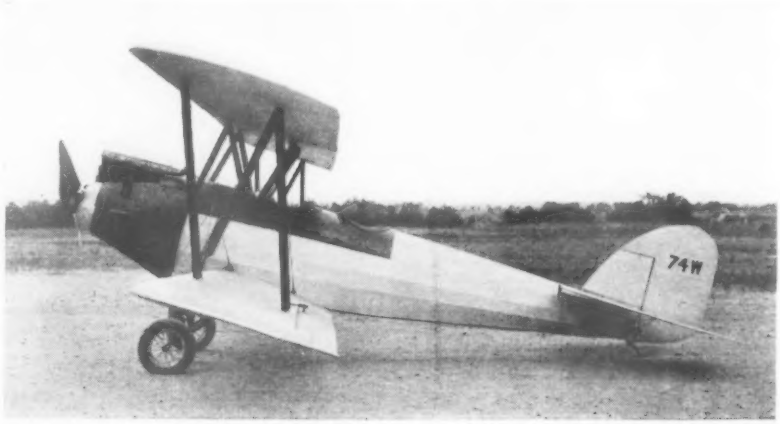
AFTER looking over the photographs and specifications of the Epps two-seater biplane, I believe you'll all agree that it's one of the finest examples of airplane construction in the country and equal in appearance and performance to any factory-built job in its class. Incidentally, this is an example of the kind of planes the anti-air craft laws of some states are keeping on the ground and the kind of work they are trying to suppress.

During the past years, home-builders of light planes have become apparently prejudiced against biplanes, especially in the two-seater class, this type being given very little attention. However, in the final analysis, a well-designed biplane has no tangible disadvantages and is even superior to the monoplane. In fact, from the home-builder's standpoint, the only objection to a biplane is the extra work required to build the second wing.

The Epps biplane was designed and built by Ben T. Epps of Athens, Georgia, who has the distinction of being Georgia's first airplane pilot. He has been flying for over 25 years, having built and flown his first ship in 1907, just four years after the Wright brothers made their first powered flight at Kitty Hawk, N. C.

Incidentally, the ship was designed with the intention of placing it on the market, but just about the time flight tests were completed the well-known depression had become such a serious matter that marketing plans were abandoned. Everything considered, it is a job that is certainly worth building and one that you will be proud of.

One of the most attractive features of the ship is that it was designed for the easily-obtainable and inexpensive Model "A" Ford motor. With this motor, it has a top speed of 70 miles an hour and a landing speed of 30 miles an hour. However, for those who want higher performance at a little more expense, any lightweight aircraft engine up to 80 or 90 horsepower may be installed.



The side elevation of the Epps light biplane, showing the simplicity of the design and the clean cut appearance of this little ship. A Ford engine is in the nose.

At present, the ship is powered with a Wright Gipsy 90 horsepower, four-in-line, air-cooled engine, which weighs 285 pounds, just about 40 pounds more than the Model "A" installation. Thus powered, the top speed is around 95 miles an hour, and the landing speed 35 m.p.h. Other suitable engines are the Warner Junior, the Menasco Pirate or the Velie M-5. A well-placed advertisement should help you locate a good second-hand engine of any of these makes. A good Model "A" Ford engine will cost about $75 to $100, including the cost of converting it for airplane use.

There is nothing about the construction of the plane that is beyond the ability of the average person, with the possible exception of the welding which should be done by a skilled welder. Also, it will pay you to study every detail of the plans carefully before beginning construction and be sure you know where every part fits.

If you do not have any experience in airplane construction, it would help considerably to enlist the help of someone who has built at least one plane. However, this is not absolutely necessary if you will follow the plans and instructions carefully and not try to rush things.

Take your time, and remember that not only your life, but also your passenger's, depends on your workmanship. The best of materials are none too good. Order them from reliable supply companies, and don't skimp on any of the parts. Do this and your plane will be as safe as any factory-built job. Often, expensive material is cheap in the long run.

Before actually beginning construction of the plane, make an itemized list of everything that will be needed, even to screws and thread. You'll find this will be very convenient and will save a lot of time. The cost of all materials, not including the motor, will vary considerably due to changing market prices but should not exceed $500. If you can't afford that much, you might get another fellow to share ownership of the plane with you.

Ordinary hand tools, such as you probably already have on hand, are all that are needed, but, of course, if you have any motor-driven tools, such as a band-saw, it will speed up the work considerably.

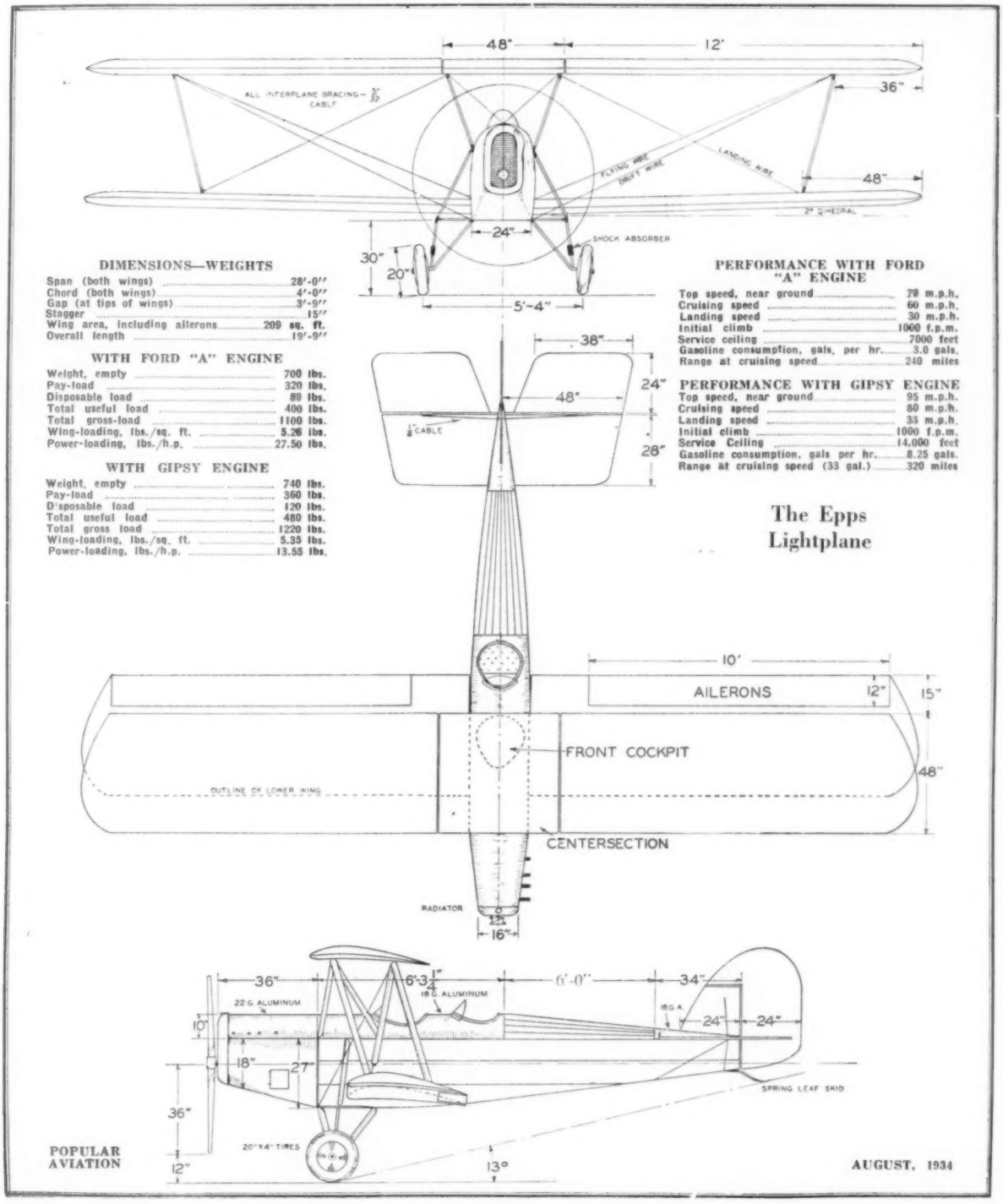
Here are the tools you need: A bench vise, hand drill with an assortment of drills up to ⅜ in., screwdrivers, monkey wrench, pliers, an as-

(*Concluded on page* 106)

Front elevation of the Epps biplane. It is a simple and economical plane for the amateur builder and flyer.

Scale Plans of the Epps Plane

Below will be found a three-view drawing which shows the overall dimensions of the Epps light biplane, its weight and performance. Two motors are compared in regard to performance and weight, a converted Ford engine and a Gipsy or similar aviation engine.



DIMENSIONS—WEIGHTS

Span (both wings)	28'-0"
Chord (both wings)	4'-0"
Gap (at tips of wings)	3'-9"
Stagger	15"
Wing area, including ailerons	209 sq. ft.
Overall length	19'-9"

WITH FORD "A" ENGINE

Weight, empty	700 lbs.
Pay-load	320 lbs.
Disposable load	80 lbs.
Total useful load	400 lbs.
Total gross-load	1100 lbs.
Wing-loading, lbs./sq. ft.	5.26 lbs.
Power-loading, lbs./h.p.	27.50 lbs.

WITH GIPSY ENGINE

Weight, empty	740 lbs.
Pay-load	360 lbs.
Disposable load	120 lbs.
Total useful load	480 lbs.
Total gross load	1220 lbs.
Wing-loading, lbs./sq. ft.	5.35 lbs.
Power-loading, lbs./h.p.	13.55 lbs.

PERFORMANCE WITH FORD "A" ENGINE

Top speed, near ground	70 m.p.h.
Cruising speed	60 m.p.h.
Landing speed	30 m.p.h.
Initial climb	1000 f.p.m.
Service ceiling	7000 feet
Gasoline consumption, gals. per hr.	3.0 gals.
Range at cruising speed	240 miles

PERFORMANCE WITH GIPSY ENGINE

Top speed, near ground	95 m.p.h.
Cruising speed	80 m.p.h.
Landing speed	35 m.p.h.
Initial climb	1000 f.p.m.
Service Ceiling	14,000 feet
Gasoline consumption, gals per hr.	8.25 gals.
Range at cruising speed (33 gal.)	320 miles

The Epps Lightplane

Epps Lightplane

(*Continued from page* 104)

sortment of cabinetmaker's clamps, brace and bits, small hammer, heavy metal shears, hacksaw with plenty of blades, coarse and medium files, coping saw, ripsaw, cross-cut saw, nail-set, center punch, and a machinist's hammer. Besides these tools, you should have a good supply of sandpaper.

A roomy well-lighted shop with plenty of floor space should, if possible, be chosen in which to build the ship. However, if you're really anxious to build it, you won't let the lack of space stop you.

Both wings of the Epps biplane have an overall span of 28 feet and a chord of 4 feet. The ailerons are located on the lower wings only, and are of large area to insure adequate control at stalling speed. They are operated by bell-cranks and push-pull tubes. The elevators are also operated by a push-pull tube. Both cockpits are roomy and comfortable, visibility being excellent from either seat. Dual controls are provided. Those in the front cockpit can be removed or replaced in a few moments.

In the Gipsy-powered job, an extra gasoline tank has been installed on top of the center section, as may be seen in some of the photos. With the Ford engine, the fuselage tank has sufficient capacity, so the center-section tank isn't necessary unless you want a longer cruising range. Also, notice that a slight modification has been made in the landing gear since installation of the Gipsy motor; a "V" brace has been added on each side between the fuselage and shock struts.

BUILDING THE RIBS

The ribs are made of ¼ x ⅜ in. spruce, the joints being made with 1/16 in. plywood gussets, glued and nailed in place. The front part of the rib is sawed from ⅜ in. plywood, hollowed out for lightness as indicated in the plans. In selecting material, be sure that it is entirely free from defects, and of the best quality obtainable.

The first thing to do is to make a rib mould. Following the dimensions given in the accompanying drawings of the rib, make a full-size pattern on a heavy sheet of wrapping paper. Glue it to a heavy board about 8 in. wide and 5 feet long, smoothing out all wrinkles. Then, nail strips of ⅜ in. square material around the outline and on each side of the truss member positions to hold the members in place for assembly.

Cut a supply of gussets from th 1/16 in. plywood. Place the members of the the rib, cut to length, in the mold. Apply freshly-mixed casein glue to both joints and gussets, nailing the latter in place with ¼ in. x 20 ga. nails. When all joints are dry, turn the rib over and fasten gussets on the opposite side in the same manner. You will need 37 full-length ribs, and 18 ribs extending back only as far as the rear spar will be needed on the lower wing at the aileron position.

Note that the end ribs of the center section and wing panels are covered on the outside with 1/16 in. plywood, consequently, gussets will not be needed except on one side of these ribs.

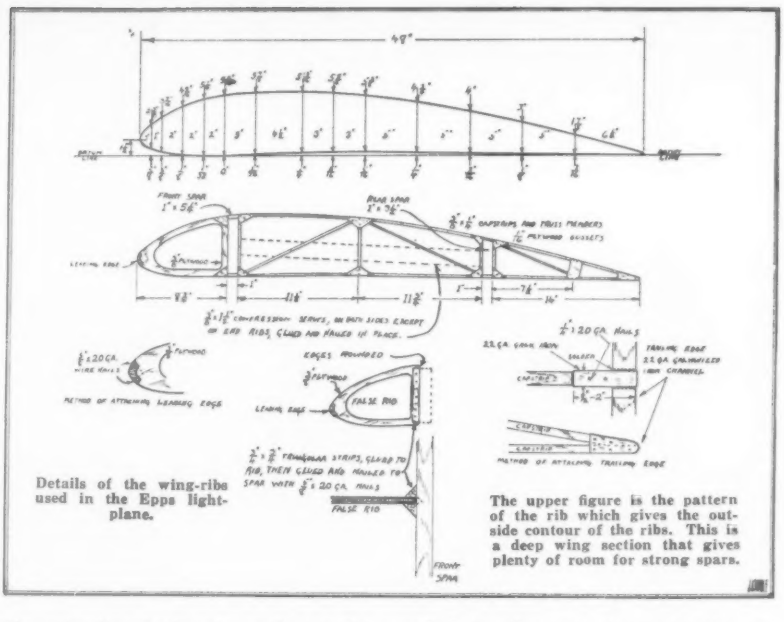
There are 18 compression ribs in the entire wing assembly—two in the center section and four in each wing panel. These are just regular ribs with the compression struts glued and nailed in place as shown in the rib drawing. You will have to cut a notch ¾ in. wide and 1/16 in. deep in both ends of the compression struts, and in the vertical rib members next to the spars. This is to provide clearance for the internal brace wire fittings, which are installed after the ribs are fastened on. Note that the end ribs in the center section and wing panels have a compression strut on one side only.

The full-length ribs adjacent to the ailerons have the part behind the rear spar covered on the outside with 1/16 in. plywood. Keep this in mind when making these particular ribs, and leave the gussets off where the plywood reinforcement goes.

In making the aileron ribs, of which 24 will be needed, the rear part of the regular rib mould may be used by modifying it slightly, though it would probably be just as easy to make a separate mould. The aileron horn, it will be noted, is mounted on an extra rib, installed between the regular ribs, covered on both sides with 1/16 in. plywood, no gussets being required. Before covering it, however, glue in a ⅜x1½ in. filler block of hardwood at the front of the rib where the horn attachment bolts go through. Also cover the end ribs of the ailerons on the outside with 1/16 in. plywood.

You'll need 50 false ribs in the wing assembly. That sounds like quite a bunch, but since they are sawed from plywood, you can cut out several at a time. Use the same pattern you used in making the front part of the regular ribs, but leave out the notches for the capstrips, since they, of course, won't be necessary. Round off the edges to prevent them from cutting the cloth. A ¾x¾ in. triangular strip of wood is glued and tacked to each side of the false ribs, as indicated in the drawings.

END.



Details of the wing-ribs used in the Epps lightplane.

The upper figure is the pattern of the rib which gives the outside contour of the ribs. This is a deep wing section that gives plenty of room for strong spars.

Specifications of the Epps Biplane

Span, both wings	*28 ft.*
Chord, both wings	*4 ft.*
Gap between wings	*3 ft. 9 in. at tips*
Stagger	*15 in.*
Angle of incidence, upper wing	*3 degrees*
Angle of incidence, lower wing	*1½ degrees*
Dihedral, upper wing	*0 degrees*
Dihedral, lower wing	*2 degrees*
Total wing area, including ailerons	*209 sq. ft.*
Aileron area, each	*10 sq. ft.*
Length of plane, over all	*19 ft. 9 in.*
Height, over all	*7 ft. 9 in.*

WEIGHTS, WITH FORD MODEL "A" MOTOR

Weight empty	*700 lbs.*
Pay load	*320 lbs.*
Disposable load	*80 lbs.*
Total load	*400 lbs.*
Weight loaded	*1100 lbs.*
Wing loading	*5.26 lbs. per sq. ft.*
Power loading	*27.5 lbs. per hp.*

What Our Readers Are Building

A department devoted to our readers' activities in airplane, glider and engine construction, showing the latest developments.

Read About 'em Here

E. B. GORHAM, 3439 Drummond Place, Chicago, Ill., starts the ball a-rolling with his neat little ship. It took him 18 months to complete the job, only to discover that it cannot be flown in the State of Illinois and that the U. S. Department of Commerce will not issue an experimental license for it. And ain't that tough?

The ship has a span of 27 feet and a wing area of 110 square feet. It is provided with a wide split landing-gear and welded steel fuselage. You will note the automatic banking vanes on top of the wings. A Heath-Henderson engine powers the job but, so far as practical results are concerned, it might just as well be without an engine. The state laws have bitten again.

And now we have the monoplane constructed by Charles Michalski, 85 Ames St., Methuen, Mass., who gives us a more complete story of his undertaking than in a previous issue. He started to build the ship in a Boston lodging house and completed the wings, fuselage and tail surfaces there.

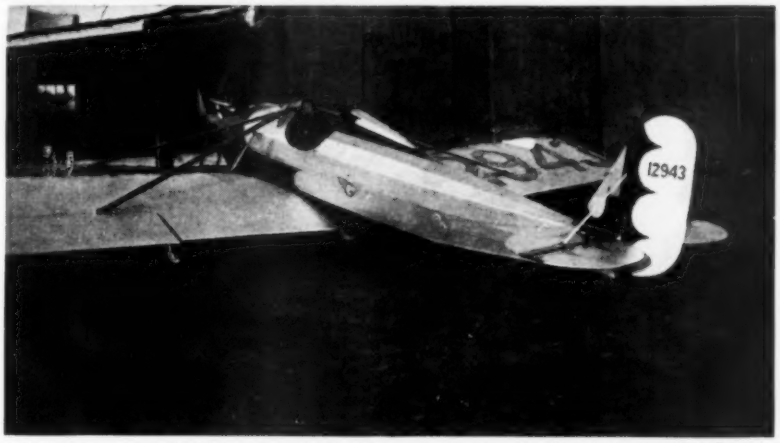
Quite often, he says, he had to stick part of the fuselage out of the window to get room to work in. And then came the problem, one Sunday morning, of getting the plane out of the room. The window frames came out, and after four hours work the parts were on a truck headed for his father's home. And he says, "the lodging-house keeper almost went nuts when he saw his window out."

Then came the covering and an inspection by a transport pilot who proclaimed the job O. K. and agreed to test hop the ship. However, the inspectors got wind of it and told him that it would be just too bad if they were caught flying it. Well, there's just one more lightplane for sale cheap. That's the answer.

A letter from Herbert F. Orton, vice-president of the Oregon Lightplane Association, is a welcome addition to this department. He sends us a picture of a sweet looking little ship built by Walter Rupert, 1000 Michigan Ave., Portland, Ore., for which we thank him.

This ship was formerly powered by a Henderson engine but that kicker has now been replaced by a Salmson. And it sure has performance for on test it showed 1,200 feet-per-minute climb and a top speed of about 110 m.p.h. It has a 27 foot Clark "Y" wing and weighs about 425 pounds. Friese type ailerons are fitted and the fuselage is provided with a side-door like a Heath.

Two of These Planes Are Grounded—One Flies



E. B. Gorham built this little ship only to get turned down by the Illinois Aeronautical Commission after it was completed. Just one more victim of a fool law that has tied up aviation indefinitely in this state.

And now we show the fine little plane built by Charles Michalski, who started the job in a Boston rooming-house and, finally, was grounded by the Massachusetts state authorities.

Walter Rupert, builder of this fine little ship, is fortunate to live in Oregon. He and the other members of the Oregon Lightplane Club are free to fly as they please in Oregon without interference.

The Straughan Ford-Engined Biplane

The Straughan biplane is a remarkably clean looking little ship with the Ford engine neatly cowled and with a sturdy looking landing-gear. The side-by-side seating arrangement makes it ideal for instruction.

THIS new plane, recently developed by the Straughan Aircraft Company, Wichita, Kansas, is a two-place open land biplane with side by side seating arrangement to be used mainly as a training plane.

It is designed for building up flying time for students and is powered by a Model A Ford motor. Aside from being powered with the Ford engine, it is just a simple sturdy biplane. It is licensed to carry 1,000 pounds, weighs 581 pounds empty, 998 loaded and without the Ford engine installation the ship itself only weighs 292 pounds. The plane, even with the engine, is so light that one man can handle it alone.

The engine is enclosed with hinged cowling that tightens down with fasteners like those used on suit-cases, which makes the engine readily accessible. Magneto ignition is used for the ignition equipment. The wings are of conventional wood and fabric construction and the fuselage and tail are made of chrome steel covered with fabric.

The wing span is 28½ feet, while the length of the plane over all is 19 feet, 8½ inches. Propeller speed at cruising is 1,700 revolutions per minute and top speed at 1,900 r.p.m. This plane has the shock type landing gear in conjunction with air wheels and dual controls with standard equipment. It will land and take off in small fields, only ninety steps being taken until it is off with a full load, in seven and five-tenths seconds. It is guaranteed to not go into a tail spin.

It will climb 400 feet in the first minute and has a landing speed of 28 miles per hour. The service ceiling is estimated at 10,000 feet with an absolute ceiling of 12,500 feet. The cruising speed is 68 miles per hour, while the top speed is 78 miles per hour. It has a cruising radius of 140 miles.

The gasoline tank on this little plane has a capacity of seven gallons, which enables it to fly for two hours between re-fueling times. The fact that the plane is small enough to land on the highways and that the Ford engine uses ordinary automobile gasoline and oil makes it a good patron of any ordinary filling station. Ordinary Ford parts are used in making repairs.

The Straughan price is $990 f.o.b. Wichita. This low price, and the economies obtained in the operation of the plane on account of using the Ford engine, in the opinion of the manufacturers, places it so far in advance of the present low-priced production plane.

SPECIFICATIONS FOR STRAUGHAN BIPLANE

Wing span	28 ft. 6 in.
Length overall	19 ft. 8½ in.
Cruising speed	68 m.p.h.
Top speed	78 m.p.h.
Landing speed	28 m.p.h.
Service ceiling	10,000 feet
Absolute ceiling	12,500 feet
Cruising radius	140 miles
Weight empty	581 lbs.
Gross weight	998 lbs.

It rather appears that this is a direct answer to Director Vidal's prayer for a $700 plane, for undoubtedly it could be brought down to this figure if placed in quantity production. It is just this sort of plane that will popularize aviation with the masses and bring down the cost of training within the reach of the average aviation fan.

The adoption of light motor-car engines for lightplanes is one of the prominent factors entering into the solution of the low cost problem, for they can be obtained at a cost far below that of the cheapest aviation engine, are strong and rugged and eliminate the necessity for fancy aviation gasolines and oils. It is likely that solo flying could be sold at a profit at the modest rate of $2.00 to $3.00 per hour.

In its general arrangement and performance, it checks up rather closely with the Epps lightplane described in this issue which is also Ford powered.

What Gen. Mitchell Thinks

BRIGADIER-GENERAL WILLIAM E. MITCHELL is ready to take over the leadership of the new federal department of aeronautics, if and when one is created.

The man who commanded America's war pilots in battle and who was afterwards court-martialed for criticising her air policy,—hard-hitting self-confident critical "Billy" Mitchell—is being listened to these days as he talks about the future of aviation and a unified air policy.

An independent unified air force has been his cry for years,—a more or less unheeded cry. People called his ideas wild and visionary. They intimated that his place was on his Virginia estate, fox hunting, rather than trying to dictate to the government. But today, with aviation policies being overhauled and with the growing knowledge that this nation ranks behind other major powers in the air, General Mitchell's views seem much more sane and sound to aviation leaders, congressional committees and to air-minded people in general.

He is the same jaunty swaggering figure as of yore, in a gay checked suit and spats, tan shoes and a light felt hat—swinging his inevitable cane. He still talks fast and confidently and one feels that he has the whole air set-up planned to the last minute detail. His mind is the true mind of a General, mapping out complicated campaigns effectively.

"I would airplanize the world, the way we motorize it," was one of his remarks. And—"I'm for airships, 100 percent."

"We have got to get a brand new air policy and a means for carrying it out," he continued. "We must create, equip and train an air force and foster civil and commercial aviation so as to make it a leading factor in the country."

He believes that the army should carry the mail, but that it will take three or four years for the army boys to regain "their lost art of flying," an art which was lost because economy measures, enforced by army leaders, did not permit them to have enough flight training.

"They were only allowed a two hour's flight from the army base, because the Army was afraid they might break up a ship," he stated.

Mitchell believes that commercial lines should have straight-out subsidies for passenger flying. "All passenger ships should be equipped with cabin parachutes, which are now perfected so that they can let down 12 people at once," he declared. Defrosting and blind flying equipment which will lick the weather hazards should be on every ship. Many of the ships flown on passenger-carrying lines now are unsafe, he believes.

"There are three things on which we must concentrate," he continued. "We must carry passengers at a reasonable rate of speed, getting the greatest

(*Concluded on page* 126)

Building the Monocoupe D-145

by
PAUL W. LINDBERG

Model designer and Model Editor of
POPULAR AVIATION.

This photo does not do justice to the fine appearance and the excellent workmanship displayed on our "lab" model. It is one of the finest we have yet produced.

WE have had a great number of letters in the past requesting that we run plans of the Monocoupe. We have gone one better and have gathered the material on the newest Monocoupe Model D-145. This model has very clean lines and is a crack flyer.

During the construction of this model in our laboratory, we devised a method of installing removable wing panels, so that the model may be placed in a small box when traveling to and from your flying field.

The model has all adjustable controls with aluminum hinges, fool-proof shock-absorber, new improved method of building the motor, and all the details necessary for completing an authentic flying scale model.

In building the model, all dimensions can be quickly and accurately determined by placing a ruler on the part to be measured. The plan is printed full size. If you wish a larger model, multiple this measurement by the amount of increase.

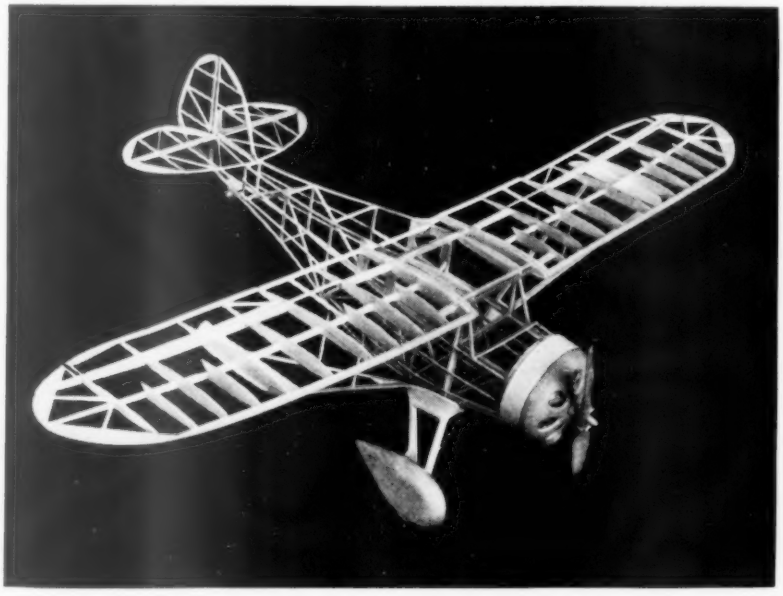
The color scheme of fuselage, wings, empennage is Diana Cream, the remainder of the ship being trimmed in red with a white pin stripe bordering same.

CONSTRUCTION OF FUSELAGE

The fuselage sides are built from $\frac{1}{16}$" square balsa. The longerons, verticals, diagonal braces, etc., are held in place until securely cemented, by inserting straight pins on either side of strips wherever needed. After the two sides are completed, the cross-members are cemented into their proper locations. Check carefully from front to rear for alignment.

Cut the formers from $\frac{1}{32}$" sheet balsa and cement in their respective positions as shown on the plan. The balsa ring which fits on front of fuselage, is cut from $\frac{1}{8}$" thick balsa and cemented together as shown on the plan. After this has been properly shaped and sanded cement to front end of fuselage. The $\frac{1}{32}$"x$\frac{1}{16}$" stringers should now be cemented over the formers on the fuselage.

Please note that stringers are cemented to outer edges of formers so that a smooth covering job may be obtained. This eliminates all projecting formers. A stiff grade of paper is used for cowls 1 and 2 between balsa nose ring and formers 1 and 2, templets of which are clearly printed on plan.



The frame work of the Monocoupe D-145 before covering. Note the window in the upper wing.

MOTOR COWLING

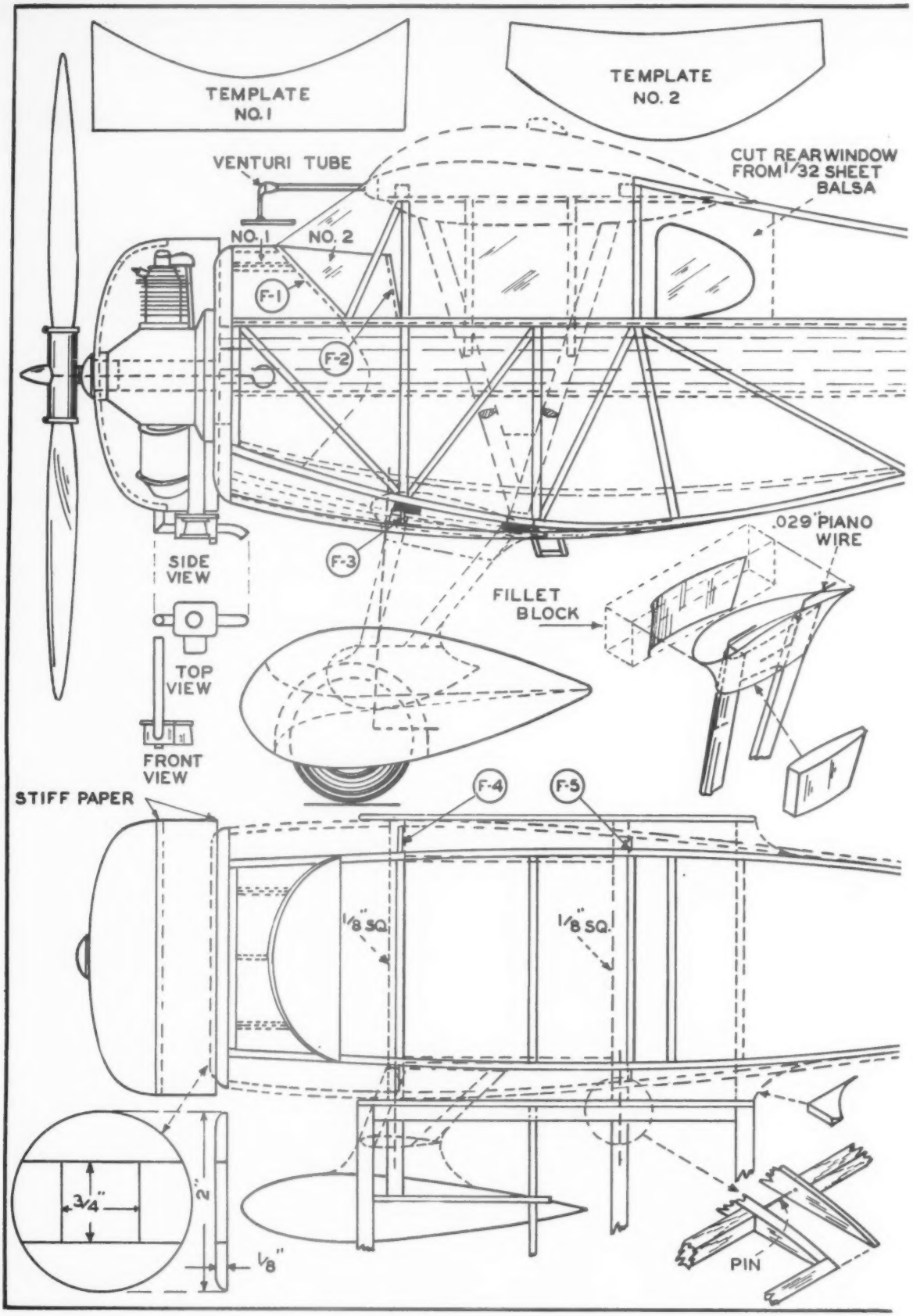
The front part of cowl is carved and sanded to shape from a balsa block. Use a stiff grade of paper for rear part of cowl which is cut $\frac{1}{2}$" in width. Cement to balsa cowl, overlapping balsa $\frac{1}{16}$". Lower rear part of cowl is cut away to permit carburetor to project through.

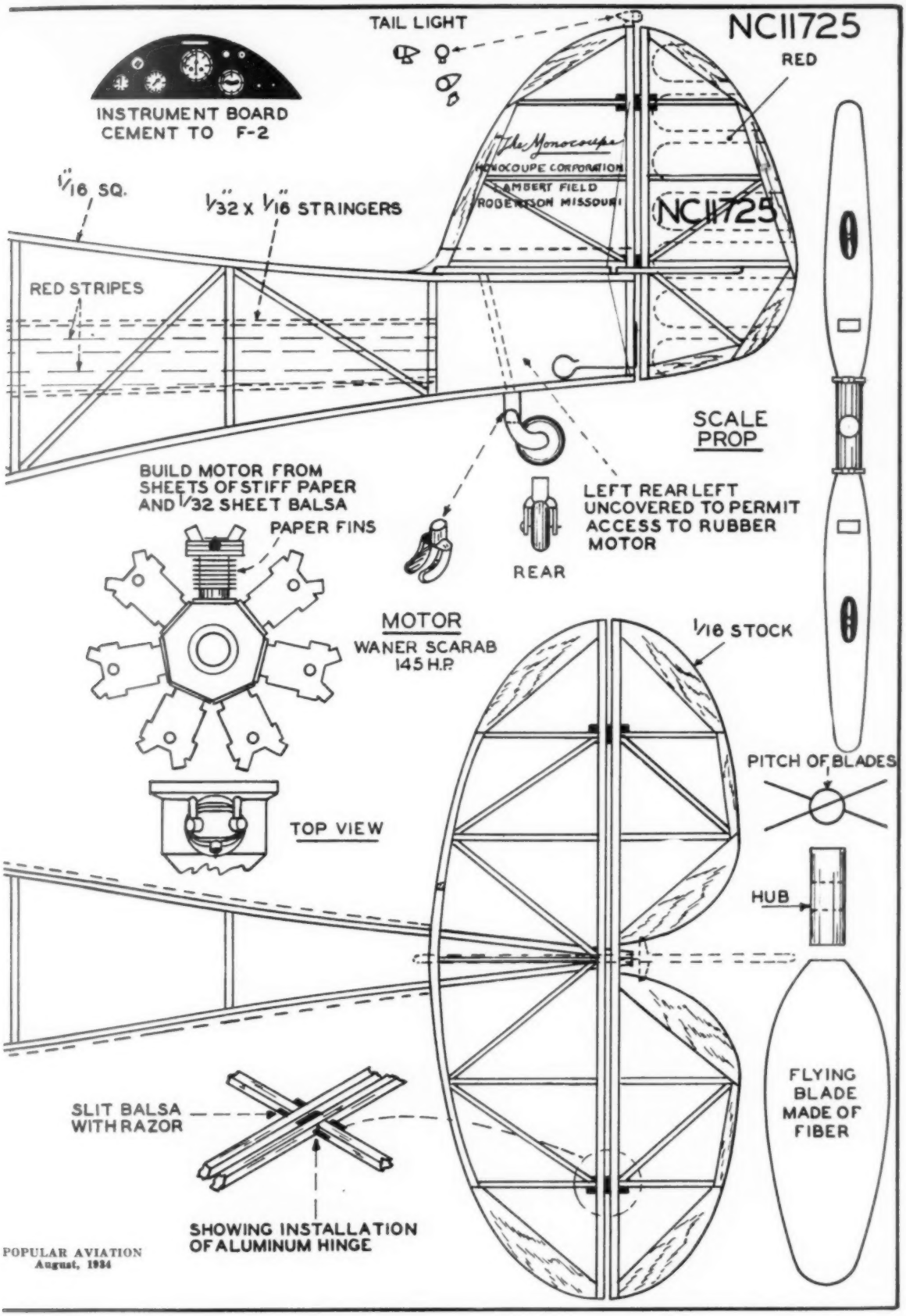
DUMMY MOTOR

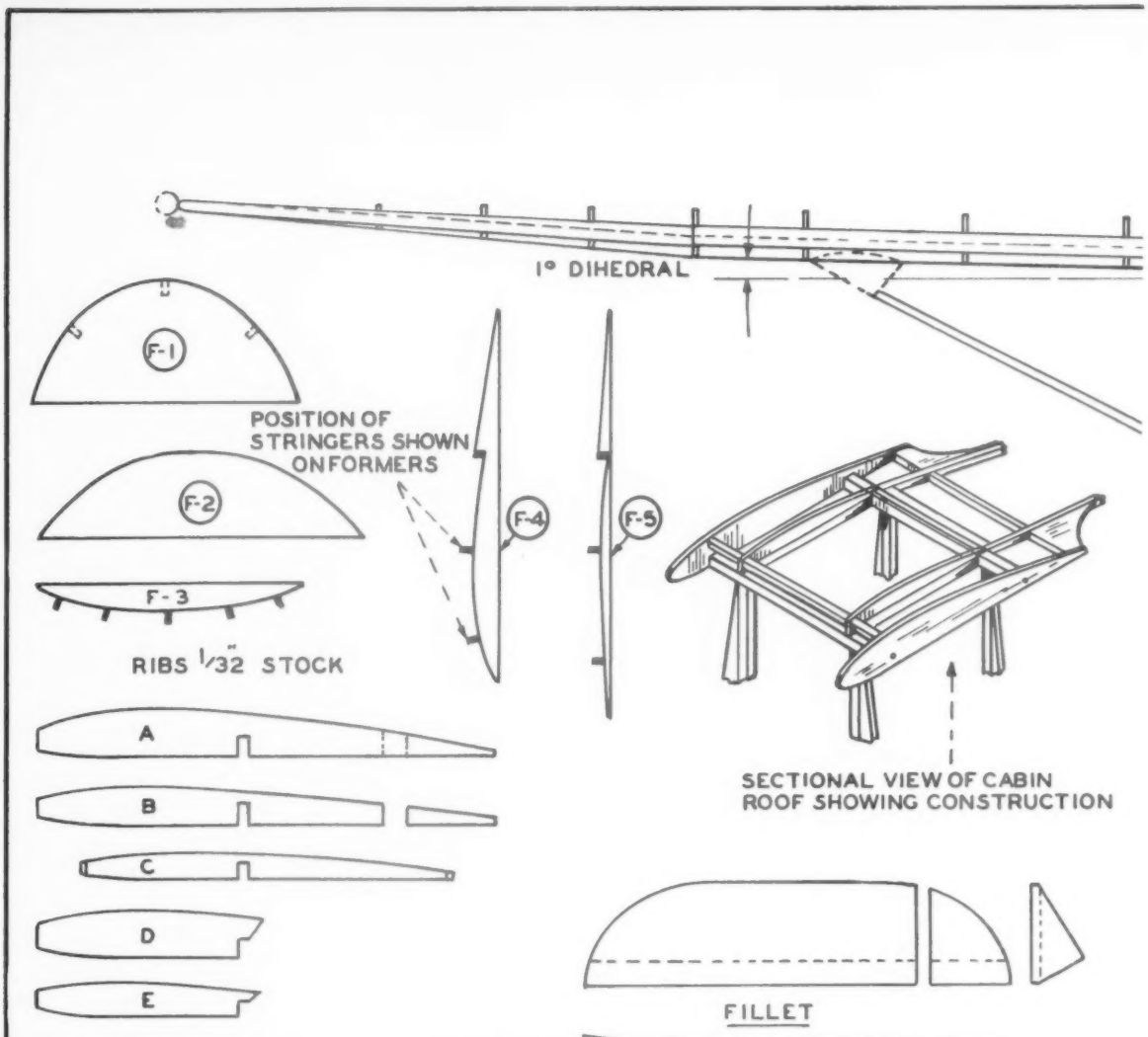
The motor is built up entirely from balsa and sheets of paper. The cylinders are built first, using the sheets of paper cut into disk, etc., to represent the fins. The layers in between these are made of sheet balsa $\frac{1}{32}$" in thickness.

These are cut smaller so as to make the cylinder more realistic. The crankcase should be made from layers of $\frac{1}{8}$" stock, cemented together and shaped as shown on the plan. A solid block of balsa may be shaped up equally as

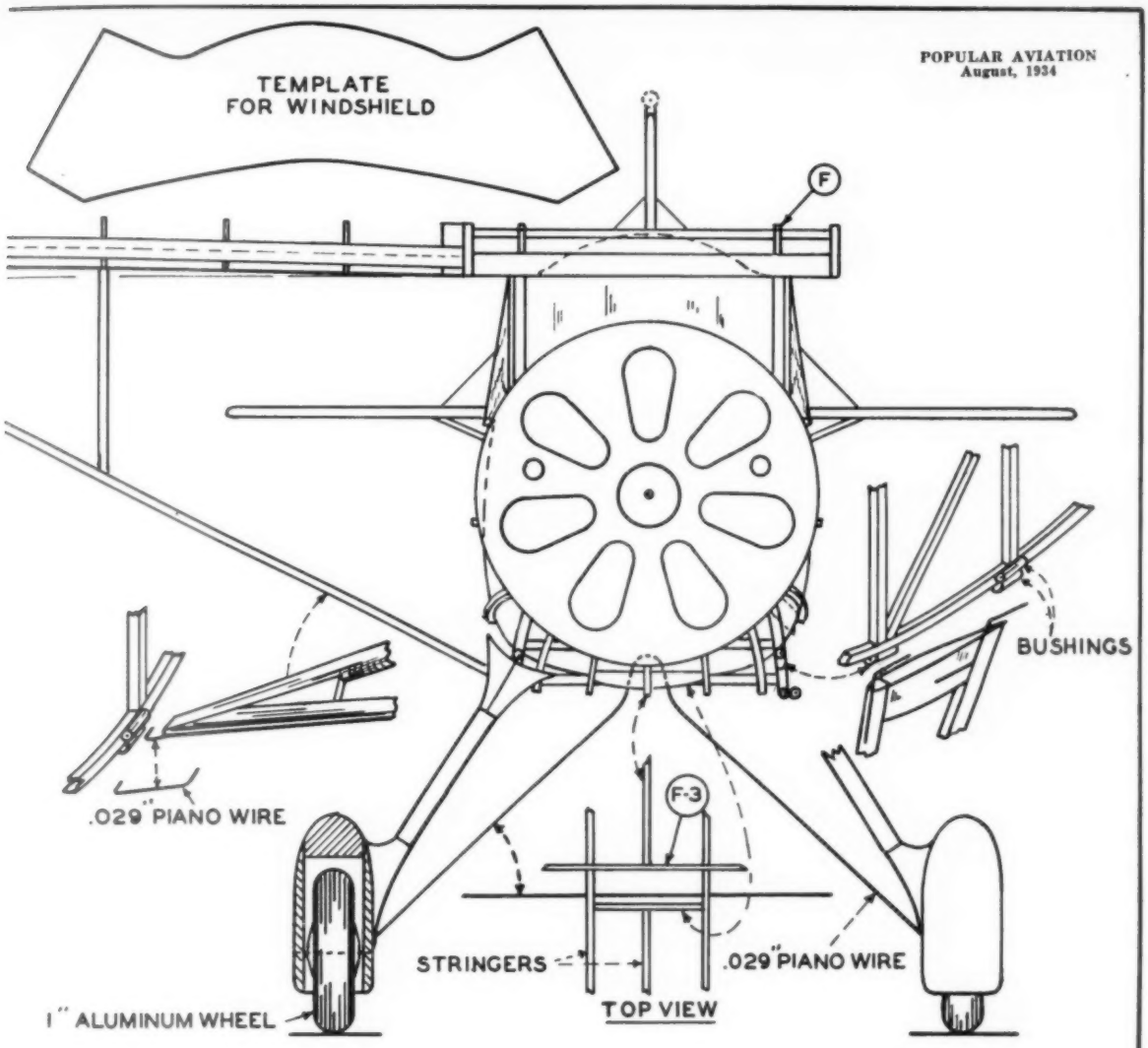
(*Concluded on page* 114)

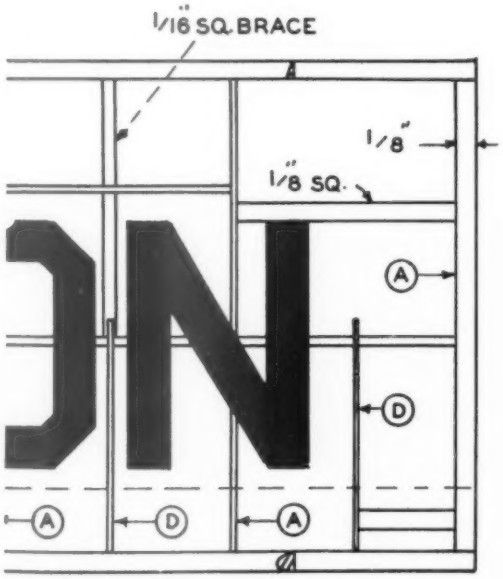

TEMPLATE NO. 1
TEMPLATE NO. 2
VENTURI TUBE
CUT REAR WINDOW FROM 1/32 SHEET BALSA
NO. 1
NO. 2
F-1
F-2
F-3
SIDE VIEW
TOP VIEW
FRONT VIEW
.029" PIANO WIRE
FILLET BLOCK
STIFF PAPER
F-4
F-5
1/8" SQ.
1/8" SQ.
3/4"
2"
1/8"
PIN

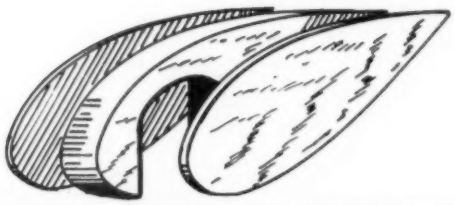

TAIL LIGHT
NC11725
RED
INSTRUMENT BOARD
CEMENT TO F-2
The Monocoupe
MONOCOUPE CORPORATION
LAMBERT FIELD
ROBERTSON MISSOURI
NC11725
1/16 SQ.
1/32 X 1/16 STRINGERS
RED STRIPES
SCALE
PROP
BUILD MOTOR FROM
SHEETS OF STIFF PAPER
AND 1/32 SHEET BALSA
PAPER FINS
LEFT REAR LEFT
UNCOVERED TO PERMIT
ACCESS TO RUBBER
MOTOR
REAR
MOTOR
WANER SCARAB
145 H.P.
1/16 STOCK
PITCH OF BLADES
TOP VIEW
HUB
FLYING
BLADE
MADE OF
FIBER
SLIT BALSA
WITH RAZOR
SHOWING INSTALLATION
OF ALUMINUM HINGE


1° DIHEDRAL
F-1
POSITION OF STRINGERS SHOWN ON FORMERS
F-2
F-4
F-5
F-3
RIBS 1/32" STOCK
SECTIONAL VIEW OF CABIN ROOF SHOWING CONSTRUCTION
A
B
C
D
E
F
FILLET
CUT AND BEND UP AT THIS POINT IN ORDER TO GAIN DIHEDRAL IN TIP
G
H
NOTE
TO DUPLICATE RIGHT WING PANEL TRACE SAME ON WAX PAPER REVERSE AND CONSTRUCT LEFT PANEL
NAVIGATION LIGHT
1/16 STOCK
CUT
RED

POPULAR AVIATION
August, 1934







BUILD WHEEL COVERING FROM THREE PIECES AS SHOWN

COLOR SCHEME

FUSELAGE ---------- DIANA CREAM
WINGS ELEVATOR & RUDDER " "
DETAIL ---- --- ---- RED & BLACK

MONOCOUPE

MODEL D-145

FULL SIZE PLAN
SCALE 5/8" = 1'-0"

Monocoupe D-145

(*Continued from page* 109)

well. After the cylinders and crankcase have been completed, cement the seven cylinders in their proper locations on the crankcase.

The rocker-arm caps and push-rods should be shaped and cemented to the motor. Paint cylinders black, crankcase aluminum, push-rods aluminum, other small detail, black.

LANDING GEAR

Select a fairly strong grade of balsa and shape all landing gear struts as shown on plan. Small pieces of piano-wire are cemented to the front and rear part of struts, which in turn are received by bushings cemented to bottoms of longerons.

The streamline wheel coverings are cut to shape and built up in three sections. Carefully carve and sand to a streamline form so that they may be cemented to landing gear struts, which carry a fairing at lower ends of struts. The fairings at top of struts are carved and sanded from a soft grade of balsa.

Allow a little clearance between fuselage and fairings, so that action of shock absorber may take place without fairings binding against fuselage. The shock absorber is formed from a piece of 0.29 piano wire, this being cemented securely to streamline wheel coverings, and left free where it enters fuselage.

CONSTRUCTION OF WING

Cut all ribs from $\frac{1}{32}$" sheet balsa. Lay a sheet of wax paper on the plan and pin leading and trailing edges and center spar in position. The ribs are now placed in an upright position in their proper locations and cemented.

Make wing tips as shown on the plan from $\frac{1}{16}$" sheet balsa. We recommend this type of wing tip, as it is far simpler to construct and neater in appearance.

The ailerons are now built into the panels. Ailerons will eliminate the need for building "wash-in" into wing. We recommend that you build your model with all movable controls, as you will need these to control your model under flight. Aluminum hinges are cemented into position after wings, etc., have been covered with tissue.

TAIL GROUP

This is made entirely of balsa and is constructed upon the plan.

COVERING FUSELAGE, WINGS, ETC.

In covering the fuselage, cover in long narrow strips, from front to rear, as this is the only way in which a smooth covering job will be obtained. When completely covered, shrink tissue with a coat of water, when thoroughly dry, give two coats of clear dope.

Wings are covered with larger sheets of tissue, as wrinkles are not apt to take place on larger surfaces. Cover tops of panels first, and finish up by covering bottoms. Cover ailerons separately. Shrink and dope in same manner as fuselage. Aluminum hinges are cemented into position.

A Replica Model of the Martin Bomber

by PAUL W. LINDBERG

(See Cover Drawing)

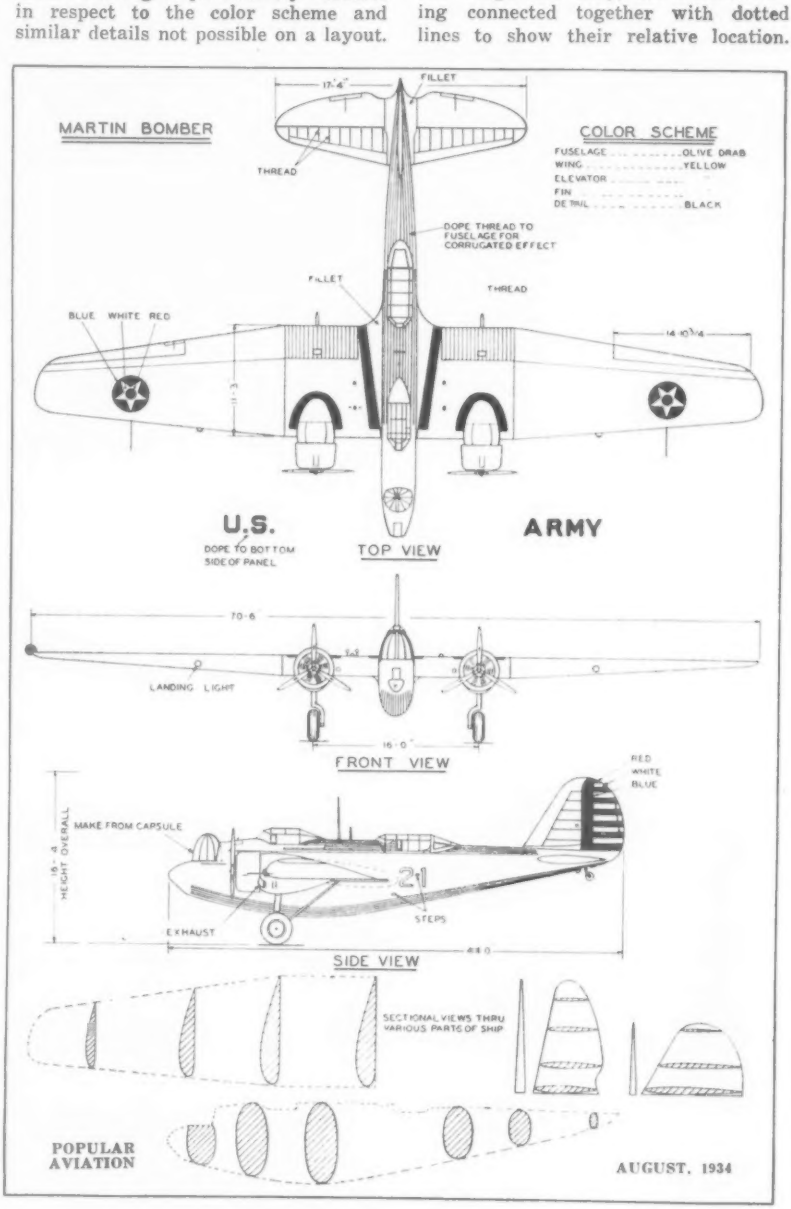
WHILE the Martin Bomber does not lend itself to flying scale model proportions, it does make a wonderfully attractive solid replica model for the ornamentation of your den or living-room. It is for this reason that I have made out the drawing below for the construction of a solid model of this ship and I trust that you will agree with me on its interesting appearance.

While the drawings are as complete as they can be made, in a three-view layout, further information can be had from the cover drawing of the Martin Bomber appearing in this issue. The cover drawing is particularly valuable in respect to the color scheme and similar details not possible on a layout.

All parts of this ship are carved out of solid balsa wood and this includes the wings and tail surfaces as well as the fuselage. The drawings show the full size dimensions of the large ship, but these can be scaled down for any desired size of model.

It is probably simplest, in making such reductions in scale, to think of the given dimensions as being inches instead of feet and then dividing them by 10, 6, 5 or whatever reduction you wish to make.

At the bottom of the sheet are cross-hatched sectional views taken through the wings and body, the sections being connected together with dotted lines to show their relative location.



What the Industry is Doing

Latest bulletins from the airplane, engine, equipment manufacturers and dealers boiled down into a nutshell. Contributions to this department are invited.

CONSOLIDATED Aircraft Company, Buffalo, N. Y., has revised the Consolidated 2-place fighter known as the P-30. This is a low-wing monoplane powered with a geared Curtiss-Wright Conqueror engine to which an exhaust driven centrifugal supercharger has just been added. Alterations have also been made in the landing gear which is now of the single strut type.

THE NEW LOUGHRAN lightplane built in Wichita, Kansas, is a Ford powered licensed job that has been attracting much attention among the lightplane fans. The price is under $1,000.

THE WHITE Airplane and Motor Co., Chicago, Ill., has just marketed a highly ingenious flight training device that can be applied to an ordinary bicycle. This consists of a "stick-control" attached to the handle-bars of the bicycle in such a way that the bicycle is balanced by the stick just as lateral control is handled in an airplane.

A NEW Kinner cabin-plane, the Model C-7, has recently been placed on the market. It is similar to the 1933 "Playboy" except that it is provided with a seating capacity for four and has a larger engine, a new 300 h.p. Kinner engine. The overall dimensions of the new cabin job are considerably larger than those of the Playboy. The wing span has been increased to 39 ft., 8 inches and the length to 28 feet. As before, the fuselage and tail units are of welded steel tubing while the wing spars are of wood. It is fabric covered.

THE CLEVELAND Pneumatic Tool Company, Cleveland, Ohio, offer compressed-air starting motors for cranking inertia starters on airplanes. Two types are built, one where the motor is to be a substitute for an electric motor while the other is to be applied when substituting for hand-cranking.

RCA VICTOR Company, Inc., Camden, N. J., have recently introduced the AVR-2 Radiobeacon Receiver that is applicable to any aircraft, large or small. It is of the superheterodyne type, very sensitive and highly selective.

AMERICAN Airlines are now flying "sleeper-planes" on regular schedules. These new planes provide every comfort of a railroad Pullman car and are made possible by an exceedingly effective sound-proofing method.

AIR-PASSENGER schedules based on a cruising speed of 3-miles per minute, have been inaugurated for the first time in America by TWA, Inc., using the new Douglas Airliner. It is capable of speeds exceeding 200 m.p.h. with 14 passengers, full crew and cargo. Although a newcomer to the Airways, the Douglas flagship is already a veteran having carried more than 5,000 passengers since it was delivered to the company.

PORT-A-SPRAY is a new spraying device that is charged with compressed air from an ordinary tire chuck and is then operated without the annoyance of a dragging air hose. The line is composed of two general utility sprays, a windshield spray and a combination spray that is adapted to handling lacquer as well as oil or solvents.

GENERAL TIRE AND RUBBER COMPANY have just put a new Lockheed Vega into commission for conveying company executives, sales and production officials from Akron to Mexico City. The new plane will also afford a means of testing tires. The first trip brought the president of the company from Mexico City to Akron in a day although the distance is greater than that from Akron to London, England.

THE K.L.M., the Royal Dutch Airlines, hopes to enter their new Douglas DC-2 in the Melbourne air race. The K.L.M. thinks that their chances of winning the race are not unfavorable because they say that their Dutch pilots know every blade of grass on the road up to Batavia.

Dining car service on the TWA is now a fact. The constant improvement in transport planes in regard to noiseless smooth operation has made dining and sleeper service possible.

THE AIR-EXPRESS DIVISION of Railway Express Agency announce startling gains in the volume of their business of air-shipments. The number of shipments for April, 1934, topped those of April, 1933, by 188 per cent.

WHEN Mrs. Nettie Hefter boarded a train from Chicago, bound for the West Coast, she found that she had left her eye-glasses at home. She wired her son who placed the glasses aboard a United Air Line plane and when the train pulled into Kansas City, she was handed her much needed optics.

THE NEW VULTEE transport plane is the center of attraction, these days. It has many new and practical features, the most interesting of which is probably the new type retractable landing gear.

ANYONE wishing to attend the International races can do so by taking an airliner. However, this offer is limited to relatively few people for the fare on the airliners will be approximately $3,400 and to this must be added the cost of transportation to Europe.

FAIRCHILD aerial cameras, produced in a number of types, are being employed in all branches of aerial activity from strip-mapping to aerial target practice.

ECLIPSE Aviation Corporation, East Orange, N. J., have supplied the new 12-place "Electras" with many important accessories such as direct cranking electric starters, booster coils, single-voltage battery charging generators, retractable landing-gear motors, etc.

BENDIX Corporation, South Bend, Ind., are noted for its air-minded body of employes. More than 150 of the employes have registered in the aviation ground school conducted under the direction of H. S. Cole who is also the director of the Bendix Service School.

LAKEWOOD Engineering Company, Columbus, Ohio, have announced a new system of neon flasher lights that have been approved for use at airports. As the neon lamps take very little energy, a small storage battery is employed in each lighting unit, thus doing away with the expense of underground electric cables and other complications. Such units can be operated at from 1 to 2 cents per day and the lights are visible at a distance of two miles.

WILLIAM EDWARD BOEING, chairman of the board of Boeing Airplane Company and of United Aircraft & Transport Corporation, has been awarded the Guggenheim medal, annually awarded for achievement in aircraft manufacture and air transportation.

EASTERN Air Transport have devised a new portable "gang-plank" for the convenience of passengers boarding their Condors. Essentially, this consists of a short flight of steps with handrails, mounted on wheels so that it can be quickly pushed up to an incoming ship.

THE PACKARD MOTOR CAR COMPANY has recently been assigned a most interesting patent on a glow spark-plug which, it is assumed, will be employed as future equipment. The glow spark plug solves many of the difficulties experienced at present with the high tension ignition system because there are no internal short-circuits possible with the glow type plug.

DINING SERVICE on the TWA is well established and popular with the patrons of these lines. This service is only made possible by recent developments in soundproofing and steady flying attained by the use of automatic pilots. The railroads have nothing to offer now that cannot equally be offered by the airways.

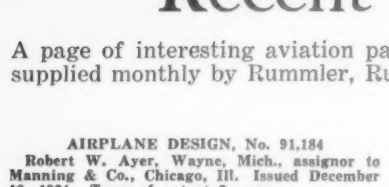
AIR-BRAKES, deaccelerators, or whatever you choose to call them, are now standard equipment on all of the transport planes now being produced and are being used in rapidly increasing numbers on sport-type planes. The Seversky is a late comer to this field.

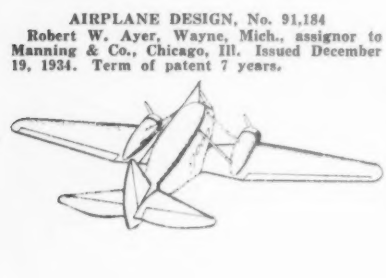
CURTISS-REYNOLDS AIRPORT, Glenview, Ill., is a busy place. The hangar certainly bears evidence of a Stinson salesman's visit for there are new Stinson cabin jobs all over the place.

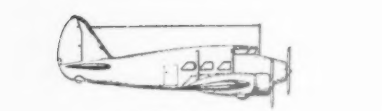
Recent Patents in Aviation

A page of interesting aviation patents issued by the United States Patent Office. This information is supplied monthly by Rummler, Rummler and Woodworth, Patent Lawyers and Engineers, 7 S. Dearborn St., Chicago, Ill.

AIRPLANE DESIGN, No. 91,184
Robert W. Ayer, Wayne, Mich., assignor to Manning & Co., Chicago, Ill. Issued December 19, 1934. Term of patent 7 years.



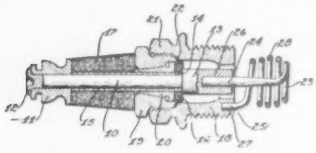




A patent on the design of a tri-motor transport plane (Stinson) with gull wings and faired wing-engines. External struts from fuselage to wings is a novel point in this design.

• • •

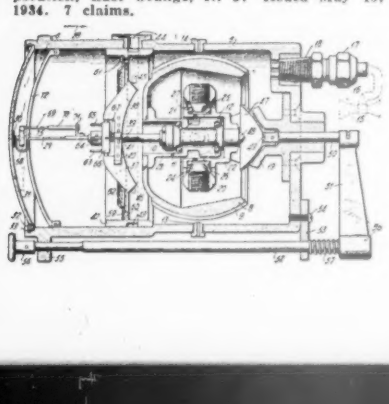
GLOW IGNITION PLUG, No. 1,957,762
Hermann I. A. Dorner, Hanover, assignor by mesne assignments, to Packard Motor Car Co., Detroit, Mich. Issued May 8, 1934. 12 claims.



An ignition plug for low tension battery current in which the igniting means is a coil of incandescent wire. The gasoline vapor is ignited by contacting the incandescent wire and not by spark.

• • •

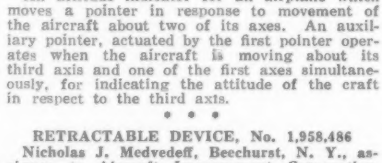
ATTITUDE INDICATOR, No. 1,959,309
Wesley L. Smith, Cranford, N. J., assignor by mesne assignments, to Eclipse Aviation Corporation, East Orange, N. J. Issued May 15, 1934. 7 claims.



An attitude indicator for an airplane which moves a pointer in response to movement of the aircraft about two of its axes. An auxiliary pointer, actuated by the first pointer operates when the aircraft is moving about its third axis and one of the first axes simultaneously, for indicating the attitude of the craft in respect to the third axts.

• • •

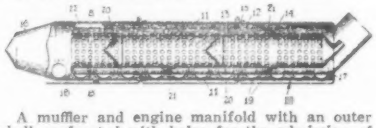
RETRACTABLE DEVICE, No. 1,958,486
Nicholas J. Medvedeff, Beechurst, N. Y., assignor to Aircraft Improvement Corporation, New York, N. Y. Issued May 15, 1934. 23 claims.



An airplane carrying a fixed wing and an auxiliary wing pivoted to the fuselage, the latter being arranged so that it can be swung from an effective flying position transversely until the wing extends flat against the fuselage.

• • •

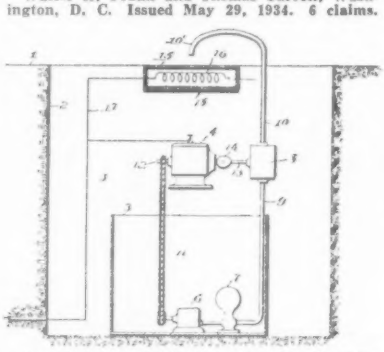
EXHAUST MUFFLER, No. 1,947,987
Charles E. Hathorn, Hempstead, N. Y., assignor to Curtiss Aeroplane & Motor Company, Inc. Issued February 20, 1934. 7 claims.



A muffler and engine manifold with an outer shell perforated with holes for the admission of the gases from the engine, the gases mingling in the outer space. The muffler is attached directly to the exhaust ports of a multi-cylinder engine and the gases are further diffused and silenced in the interior of the inner shell by expansion.

• • •

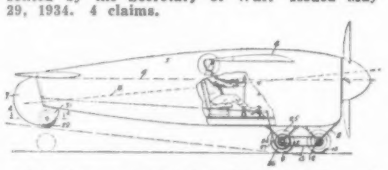
WIND INDICATOR, No. 1,960,735
Walter H. Frank and Thomas Carroll, Washington, D. C. Issued May 29, 1934. 6 claims.



A system for visibly indicating the direction and velocity of the wind at airports. A system in which the wind velocity and direction are determined by a stream of heated oil.

• • •

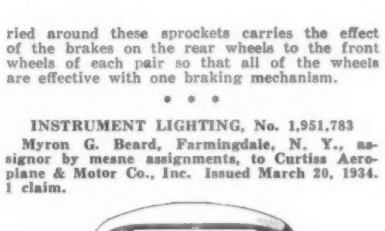
BRAKING SYSTEM, No. 1,960,762
Ellingwood H. Towle, Marchmont, N. Y., assignor to United States of America as represented by the Secretary of War. Issued May 29, 1934. 4 claims.



A landing gear with the wheels in pairs and a brake for each of the pairs. A sprocket is carried by each of the wheels and a chain carried around these sprockets carries the effect of the brakes on the rear wheels to the front wheels of each pair so that all of the wheels are effective with one braking mechanism.

• • •

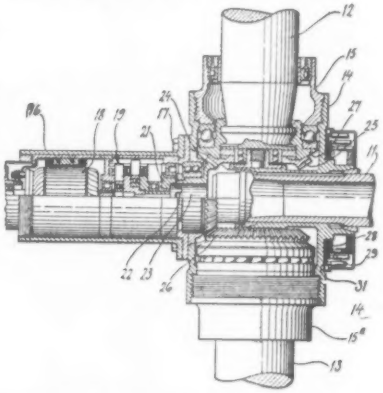
INSTRUMENT LIGHTING, No. 1,951,783
Myron G. Beard, Farmingdale, N. Y., assignor by mesne assignments, to Curtiss Aeroplane & Motor Co., Inc. Issued March 20, 1934. 1 claim.



A means for lighting an airplane instrument board by ultra-violet light. The pointers and graduations on the instruments are covered with a sensitive paint that becomes luminous when acted upon by the ultra-violet light. Two sources of light are located to the right and left of the pilot's position with a filter for each light between the light and the instruments, the filters permitting only ultra-violet light to pass.

• • •

VARIABLE PITCH PROPELLER, No. 1,951,320
Werner J. Blanchard, Hempstead, N. Y., assignor to Curtiss Aeroplane & Motor Company, Inc. Issued March 13, 1934. 10 claims.



A variable pitch propeller in which the blade angle is varied through gearing by an electric motor. A unit assembly carrying the motor and gearing is detachable from the main body for inspection and repair.

FOR a complete description of any one of the above patents, send to the Patent Office, Washington, D. C., giving the number of the patent and the name of the inventor. A fee of 10 cents will be charged for a copy of each patent. Or, you can obtain a copy from Rummler, Rummler and Woodworth, 7 S. Dearborn St., Chicago, Ill.

Stratosphere

(*Continued from page 82*)

thus be the means of saving many lives."

Samples of stratospheric air will be trapped at several levels during the flight. Later these specimens will be analyzed and studied in physical and chemical laboratories. Efforts will be made to determine the character of the ozone layer of the upper air, which some scientists assert is a sheath that saves life on the earth from destruction by ultra-short light rays.

Instruments for testing, will all be carried in the gondola which is being made at Midlands, Michigan, of Dow metal and which is very similar to the Settle balloon gondola. It is eight-and-a-half feet in diameter and painted half black and half white, as white repels the heat, and black absorbs it.

It will take a master pilot to handle the great bag, and Major Kepner with his unique record of being the only navy as well as army certified airship pilot and an airplane pilot as well, is well fitted for the job. Major Orval Anderson, former pilot of the big army blimp, the TC-13, has been chosen alternate pilot.

"It won't be any cinch to handle it," Jacobs predicted.

Providing the first flight is successful, a second stratosphere hop has been planned for September to "double check" the experiments and observations. A third flight—the first equatorial stratosphere flight ever attempted—is planned for some time next year. Thus far very little is known about the stratosphere at the equator except that it is much colder than the stratosphere at this latitude.

In order to safeguard the balloon, and protect it from curiosity seekers, R. F. Cooper, head of the Goodyear-Zeppelin balloon room, and Jacobs are planning to follow the first stratosphere flight in a plane and to be on hand when the great bag lands, ready to take charge of it.

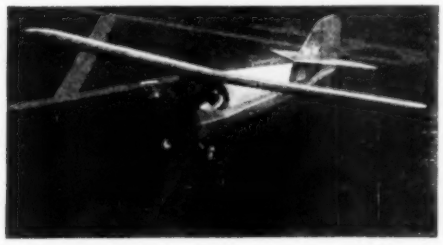
The Settle balloon was in such bad shape after its flight, that it has taken months to repair it for the Piccards' use this summer.

Because of its tremendous size, great difficulty will be had with the inflation process, even with the slightest breeze blowing. It will be remembered how difficult it was last year to get a sufficiently calm day for the take-off of the Settle balloon, and it will be doubly difficult with this latest balloon because its great area of fabric will convert every wanton whiff of air into hundreds of pounds of drag with the balloon in its partly inflated condition.

The first flight will be technically known as the National Geographic-Army Air Corps stratosphere flight.

END

ECONOMY and STABILITY Sold It



1 *Improved Aeronca Engine, all-roller and ball-bearing with impulse on magneto*

2 *Streamlined Fuselage, with comfortable leather upholstered cockpit*

3 *Completely streamlined landing gear, with single strut, chrome-moly steel axle*

4 *Streamlined Airwheels; Brakes at slight additional cost*

. . . These Improvements Are KEEPING It Sold!

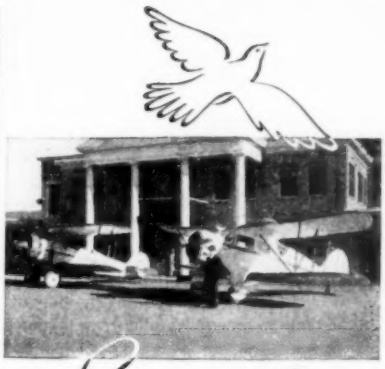
If you feel that flying is beyond your means, consider this: Aeronca cruises 28 miles on a gallon, at 77 m. p. h., flies wide open at 93, carries two comfortably in a side-by-side cockpit (with dual controls). Many consider Aeronca more rugged than heavier, costlier ships. Pilots know it is easier to fly. But everyone knows this famous ship is unchallenged under $2,000 for complete satisfaction in instruction, commercial and pleasure flying.

Write for the interesting new booklet, "Flying In Its Safest And Most Economical Form."

AERONAUTICAL CORPORATION OF AMERICA
Lunken Airport — AERONCA — Cincinnati, Ohio

Built for the Thousands Who Want a Dependable Light Plane.

Exclusive Agent for the TRIANGLE PARACHUTE, Made in the Aeronca Factory.



Even a Bird

could be PROUD OF THIS RECORD!

Above you see Dr. J. D. Brock, of Kansas City, with his two WACO airplanes.

On November 15th, 1929, Dr. Brock climbed into his WACO taperwing, shown at the left, and began a series of flights which, we believe, hangs up an all-time, all-world record. For, on November 15th, 1933, in the WACO cabin plane shown at the right, Dr. Brock completed four years of daily flights without a single interruption!

Naturally, all kinds of weather were encountered and Dr. Brock's remarkable record is a towering tribute to his extraordinary skill.

It is also a tribute, we believe, to the stamina and dependability of his two WACOs. For most of his flying was done in the two WACOs shown above!

Since November 15th, 1933, Dr. Brock has continued his daily flying. His two WACOs will continue to aid him in boosting his record to even greater heights.

* * *

The WACOs for 1934 offer more power, more speed, more room, more comfort than ever before. They are the result of advanced airplane engineering—tried, tested, and proved. Full information and specifications will be sent, upon request, without obligation. Address:

THE WACO AIRCRAFT CO., TROY, OHIO

WACO AIRPLANES

"Ask Any Pilot"

WACO LEADS IN AIRCRAFT REGISTRATION

Caterpillar

(*Continued from page* 80)

readily conceded first place to his observer, since Wacker left the ship first and landed first.

Poor Davenport, the publicity man from White City, had had no chance to save himself, for his parachute snagged on a cable of the ship before he left it. When it was finally burned free, his body dropped straight as a plummet to the roof of the bank building, where it was found later.

The newspaper man, Norton, with his parachute burning as Wacker's had been, was blown violently against the side of a building and when his parachute collapsed at the blow, he fell to his death. Weaver, the mechanic, was burned to death in mid-air, from the flames of his own parachute.

"I still have my parachute at home," concluded Wacker sadly. "It is badly torn and one side is scorched as brown as shoe-leather, while the other side is still white and clean. My boys prize it very highly."

Although he is an automobile salesman in Akron, at the present time, Wacker has never given up his interest in aviation in spite of his terrible experience and his two years of invalidism following the accident. He is always on hand at air races and air shows and has taken several cross-country flights as far as the west coast as a passenger or observer in heavier-than-air craft.

END.

Shorthand

(*Continued from page* 96)

mation is represented by an inverted V with the apex in the direction of flight. Battle front formation is represented by a single horizontal line for each element."

Thus are simple lines and curves representing fighting airplanes and squadrons enabling our sky warriors to rehearse their battles on the ground, then after performing their maneuvers in the air, to wring the last bit of experience and training from their practice by analyzing their mistakes after returning to the ground.

As a matter of fact, this system is a heritage of naval practice where the tactical maneuvers of battleships are plotted out in complex array by various symbols—mostly according to a secret code. Owing to the greater diversity of the units employed, battleships, cruisers, submarines, torpedo boats, etc., the naval terminology is even more complex than that of the Army Air Corps shown here.

But whatever may be its origin, the system is rapidly evolving into a method as concise and legible as that in any older other branch of the services.

END.

Capt. Ball

(*Continued from page* 78)

Huns who had dropped down out of the blind spot of the sun. There was a merry fight.

"My windshield was pierced in four places, finally it was shattered completely and flew away. My mirror was splintered in a thousand pieces. The bullets cracked and screamed as they tore through my fuselage. My left aileron was damaged, then I began to run short of gas. It was real sport and by the aid of luck with some good reckoning thrown in, I managed to stretch my faltering flight until I was able to land just a mile within our own lines.

"I slept near the plane and it was repaired during the night. The general came to see me on the 24th. and offered me congratulations. 'I have your name written on a big blackboard which we have stuck up in the trenches to frighten the Huns,' he said."

(Signed) Captain Ball.

Ball was promptly promoted to a captaincy and made commanding officer of Squadron 60. By September this lad, who sang in the sky, had 28 enemy aircraft officially to his credit. He was now the Ace of Aces of the R. F. C Ball, Boelcke and Nungesser, all had about the same number of victories. Only Guynemer had more victories than Ball.

On September 16, 1916, Ball won the Distinguished Service Order. Ten days later he won the "bloomin' " medal the second time with this citation:

"Remarkable courage and skill. While escorting a bombing squadron he perceived four enemies in battle formation. He dived down upon them, separated them and brought down the nearest; to assure himself of the destruction of this one Ball descended to less than 200 yards from earth. At another time observing twelve enemy planes in battle formation, he swooped down upon them and brought one down. Many others coming up, he fired three bands and brought down another. He returned to his aerodrome, passing over the lines at very low altitude, with a seriously damaged aeroplane."

On Nov. 23, 1916, Ball received the following citation:

"Remarkable courage and skill. Attacking three enemy aeroplanes he brought down one of them. He had brought down eight enemy machines in a very short time and had forced many others down out of control."

CAPTAIN ALBERT BALL, D.S.O., M.C., had twenty-nine victories to his credit when he went to London on November 18, 1916, to be decorated by the King. Lloyd George, Prime Minister, honored the Boy Ace with a breakfast. Ball's home town, Nottingham, turned out to honor their hero on February 19, 1917, when he returned home after winning his thirty-second victory.

He got a new plane, a fast little craft mounting three machine guns—two fired through the prop, the third was mounted on the upper wing and could be fired in a wide circle as well as almost straight up. He felt now he was invincible. On April 17, 1917, he returned to the front. In the pocket of his new tunic was an order for him to take command of the famous High-Hat Squadron 56.

Originally, only college graduates or sons of lords and dukes could get into this aristocratic squadron. But later, like the Cigognes, the best pursuit pilots were assigned to 56. Ball, the Boy Ace, became the "skipper" of England's most famous squadron. Only he and Jimmie McCudden of this squadron were awarded the highest of British medals—the Victoria Cross.

On his flight to "56," Ball flew into Hunland and got two enemy planes. When he landed, he learned that his number of victories over his Ace rivals had been cut down and passed. Boelcke now had 34 also and Guynemer 40—six more than Ball. The new C. O. decided to recapture first place—become the Ace of Aces of the Western Front.

No two pilots paralleled one another as closely as did Ball and Guynemer. Their temperaments were alike, they both fought furiously. Each was a remarkable marksman; both had their planes riddled countless times; both were shot down 7 times. Their victories, for months, see-sawed—first Ball had the most, then Guynemer.

April had its toll of pilots and Ball became a different boy. He seemed to have aged. His cheerful smile was only a grimace now. He didn't plant a garden that Spring. He neglected checking over his guns and plane as he always had done. Too many grueling hours in the air fighting and outmaneuvering death. Too many long hours and loss of much needed sleep pouring over paper work, trying to keep his squadron's reports up-to-date.

His men saw the telltale signs. The "skipper" was fagged. He'd done more than his share. He'd better go to England and "be a bloomin' cadet-strafin' orficer." General Higgins wanted to promote Ball to the rank of major. But Ball flatly declined. Majors only did swivel chair flying and no fighting—except possibly occasionally at a binge.

Then came through the last official citation Ball was to personally read:

"For his unfaltering and brilliant courage: from April 25th. to May 6th, he took part in 26 combats, destroyed 11 enemy aeroplanes, made two fall out of control, and forced down many others. In all these encounters Ball flew alone. On one occasion he attacked 6 enemy aeroplanes, he fought twice against 5 and once against 4. At another time, with two other pilots, he attacked an enemy formation of 8 aeroplanes. In each of these cases he triumphed over an adversary. All together Captain Ball has destroyed 43 German aero-

(*Concluded on page* 120)

The Vultee

(*Continued from page 76*)

signed, since both American Airlines and the Airplane Development Corp. are Cord subsidiary companies or have Cord affiliations, has been test flying the ship on several of its routes. The Vultee V-1A is expected to be placed on American Airlines' Chicago-Dallas-Fort Worth route, operating on approximately a 4 hr. 45 min. schedule over the 931 mile route.

One can't help but think, on appraising the ship, that the Airplane Development Corporation has an eye on the military possibilities of the Vultee as well as the commercial certainties. A military version would make an excellent attack or observation ship and the eventual development of a twin motored Vultee from the present V-1A is a logical certainty which would give us a fighter-bomber that would be almost untouchable. If the Army and Navy would buy some of the commercial ships we now have instead of the military ships they do buy, we might be closer to the top of the heap.

SPECIFICATIONS

Airplane Development Corp., Model V-1A, Vultee V-1A

Type

10-Place, Cabin, Land Monoplane (2 Pilots)

Dimensions

Length Overall	37 ft.
Height Overall	10 ft. 2 in.
Span	50 ft.
Root Chord	11 ft. 3 in.
Tip Chord	5 ft.
Mean Chord	8 ft. 4½ in.
Dihedral (Top of Wing)	3 degrees
Wheel Tread	12 ft. ¾ in.
Propeller Diameter (3-blade)	10 ft.

Areas

Wing (Including Ailerons)	384.0 sq. ft.
Ailerons	22.7 sq. ft.
Stabilizer	38.6 sq. ft.
Elevator (Including Flap)	32.5 sq. ft.
Fin	9.9 sq. ft.
Rudder	14.1 sq. ft.
Elevator Flap	2.4 sq. ft.

Volumes

Cabin	250 cu. ft.
Mail Compartment	40 cu. ft.
Baggage Compartment	50 cu. ft.

Weights*

Empty		5,212 lbs.
Gasoline, 206 Gallons		1,836 lbs.
Oil, 15 Gallons		108 lbs.
Pilots (2)		340 lbs.
Pay Load:		
8 Passengers	1,360	
Baggage and Mail	340	1,700 lbs.

Power Plant

Wright "Cyclone" Model F-2, 735 h.p. at 1900 r.p.m.

Performance

High Speed	235 m.p.h.
Cruising Speed	215 m.p.h.
Landing Speed	60 m.p.h.
Range	1,000 miles
Climb at Sea Level	1,270 ft. per min.
Service Ceiling	23,000 ft.
Absolute Ceiling	25,000 ft.

*NOTE: Above figures include Western Electric two-way radio and two airways 3-minute flares.

END.

Selley Supplies & Accessories

When you need model airplane accessories, think of SELLEY. We have the largest and most complete stock of any concern in the world. Your requirements taken care of on 24 hours' notice. Try us.

New Guns Die Cast

NEW GUNS WITH RING MOUNT
1¼" long B 25c
1⅝" long A 30c

SWIVEL TYPE GUNS C
2" Double Action 15c

PURSUIT TYPE GUNS D
¾" long 5c
1" long 8c
1½" long 8c

TYPE E
1¾" long 15c

TYPE F
1¼" long 10c

DUMMY RATCHET GUN
⅞" 10c

BOMBS AND TORPEDOES

13/16" 5c
1¼" 10c
3" Torpedo 15c

Postage 3c Each

WING AND TAIL LIGHTS

Just what you want to make your model perfect. 3 lights to a set.

For 12" model ..... 10c set
For 15" model ..... 15c set
For 24" model ..... 20c set

Packing and Postage 3c Set

PROPELLERS

HAWK TYPE 2-Bladed		HAWK TYPE 3-Bladed		STANDARD 2-Bladed		STANDARD 3-Bladed	
3¼"	25c	4"	35c	1½"	10c	1½"	10c
4"	30c	4½"	45c	2½"	15c	2½"	15c
4½"	35c	5"	50c	3¼"	20c		
5"	35c	5½"	60c	4"	25c	4"	30c
5½"	40c	6¼"	70c	4½"	25c	4½"	40c
6¼"	40c	7"	80c	5"	30c	5"	45c
7"	55c			5½"	35c		
				6"	40c	6"	60c
				6½"	45c		
				6¾"	50c		

Propellers can be had in Alum. Alloy Castings up to 12". Larger sizes are finished up to 24" diameters. Send for catalog.

Postage 3c Each

Adjustable Pitch Aluminum Propeller

Suitable for Flying Models

2-Bladed 8" dia. 35c, 10" dia. 50c
3-Bladed with Shaft 9" dia. $1.00, 11" dia. 1.25

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1/16x1/16	20	5c	1/16x6	12c
1/16x1/32	23	5c	3/32x2	4½c
1/16x⅛	16	5c	3/32x3	6c
3/32x3/32	10	5c	3/32x6	12c
3/32x⅛	10	5c	⅛x2	5c
⅛x⅛	10	5c	⅛x3	7c
⅛x⅜	8	5c	⅛x6	14c
⅛x½	6	5c	3/16x2	6c
3/16x3/16	3	5c	3/16x3	9c
¼x¼	3	5c	3/16x6	16c

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Capt. Ball

(*Continued from page* 118)

planes and one balloon. In many encounters his machine was seriously injured; once to such an extent that it required the most marvelous skill not to crash, all the wires of his controls having been cut. Each time he returned with a damaged aeroplane he at once set out again on a new one, giving always the proofs of the most extraordinary courage, of determination and skill."

Usually a citation is terse and to the point. The details of what actually transpired are omitted. Ball engaged in 26 combats and won 13 official victories. During the last week of Bloody April, Ball attacked two two-seat Albatross machines, acting as decoys with single seaters lurking upstairs.

One showed the white feather and flew away. The other, Ball attacked and with one short burst sent it down. Almost immediately five more Albatrosses came down upon him. Ball charged at the leading plane and, at the moment a collision seemed inevitable, his Vickers flashed flames and the Hun dropped, shot through the heart. The other four Germans hi-tailed it for a safer spot in the sky.

The next morning Ball, on patrol at 14,000 feet, flew near Richthofen's airdrome. He saw a Flying Circus formation of five planes climbing up for its morning patrol. Ball slipped into a cloud and waited. When the Germans were at about 8,000 feet Ball dove out of the cloud and easily picked off one of the pilots.

Then he realized the others formed a winged barrier that was set on preventing him from returning to behind his own lines. Ball attempted to force a passage, but the Germans were determined to avenge their comrade's death. They presented a solid front and were roaring toward Ball. Then the British Ace again saved his life by acrobatics. He nosed down, pulled the stick back and went into a loop.

He prayed the Heinies would attempt to follow him. They did. But in looping, their solid formation was broken open. This was what Ball was jockeying for. Quick as a flash he whipped over in a terrific attack. Before the Huns realized what was happening two more were shot down. Ball, running low on ammunition, sped homeward singing at the top of his voice.

Later he encountered two Halberstadts. Ball dove on one, shot its observer dead and conked the motor with a withering stream of lead. It went down in flames. The other Halberstadt pilot, in a frenzy of anger, sensing he too would be killed, tore in a frantic desperation straight at Ball.

The Boy Ace saw his danger. A collision in mid-air. Calmly hunched in the pit behind his guns he sprayed the on-rushing plane. At the last minute Ball heeled over and his landing wheels barely missed the wing of the German plane. Ball zoomed up to send the plane down. Two victories in less than two minutes.

* * *

THE evening of May 7, 1917, was to be a tragic one for the R.F.C. and all England. Albert Ball flew to his last fight and death. He was to meet Lothar von Richthofen, whom his brother Manfred called "The Butcher." Lothar had, in four weeks after joining his brother's Flying Circus, shot down 20 planes.

Ball took off with one of his pilots for a late patrol. Soon they encountered a German plane and after a short scrap, shot it down. And out of the battle skies came Lothar von Richthofen and three other Flying Circus pilots with thundering Mercedes and barking Spandaus.

Ball felt no particular sense of impending disaster. He had met alone, four, eight, over a dozen Hun pilots and had always come out the victor. His victories led all the aces of the world. He had demonstrated over a hundred times he could fly better than any German pilot in the air. He felt confident of this impending dog-fight.

His pilot was immediately the center of a terrific dog fight. Lothar's guns were yammering as he dove on the British pilot. The luckless man felt a stab of pain as a bullet fractured his wrist, another bullet severed the joystick. The ship, lumbering under the broken control, went down in a mad spin. Lothar, eager to kill the British pilot, dove after it.

Then Ball, seeing one of his men going down with a Hun firing at him, went white with rage. It wasn't the sporting thing to do. Ball, victor of 43 enemy planes, hopped the tail of Lothar, victor of 20.

But this battle over bloody Vimy Ridge was to be Ball's last. He hung on Lothar's tail, spraying the red Albatross with a blistering fire of hot lead. Lothar forgot the spinning British pilot below. He twisted, turned, looped and rolled. Fear came into his eyes. Here was a pilot on his tail far better than he. He went yellow. Tried to pull off and run away from the relentless pursuing enemy that hounded his backwash.

Then he cried out in pain and terror. His motor was being drilled full of holes with hot Vickers lead. He couldn't get away from those bullets. A scream of terror stuck in his throat. He was going to be killed! Why didn't some of his staffel men come to his rescue?

He nosed his Albatross down, zigzagged. On came Ball on his tail. Bullets drummed along the fuselage in a steady march of death. The instrument board was shot to splinters. Then Lothar's hip seemed on fire. Blood trickled down his leg. He struggled to land his plane in a field.

Looking up he yelled gleefully. Ball's ship was plunging down, out of control. A Hun pilot warming his guns with a short burst had accidentally sent a bullet into Ball's head.

That night Ball was reported missing. All that night anxious pilots and mechanics waited at 56's drome for some word from Ball. They were sure he would report that he was safe, alive. They knew how he could fight and fly. But the good luck cloth kitten and the riding crop had failed in their mystic duty. Lothar lay wounded in a German hospital. Ball lay dead behind the German lines.

Ball's father received the following letter from His Majesty, the King of England:

Buckingham Palace, May 28, 1917.

"It is for me a cause of sincere regret that the death of Lieutenant (with the temporary title of Captain) Albert Ball, D.S.O. and M.C. of the 7th battalion of the regiment of Derbyshire and of the R.F.C., has deprived me of the honor of myself giving to him the Victoria Cross, the highest of all the honors awarded to courage and to devotion to duty.

GEORGE, R. I."

Albert Ball, twenty years old, still the Boy Ace, was thus awarded the Victoria Cross. The first airman to be so honored. He had done what England expected every man to do—his duty.

END.

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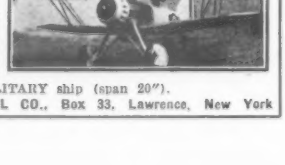

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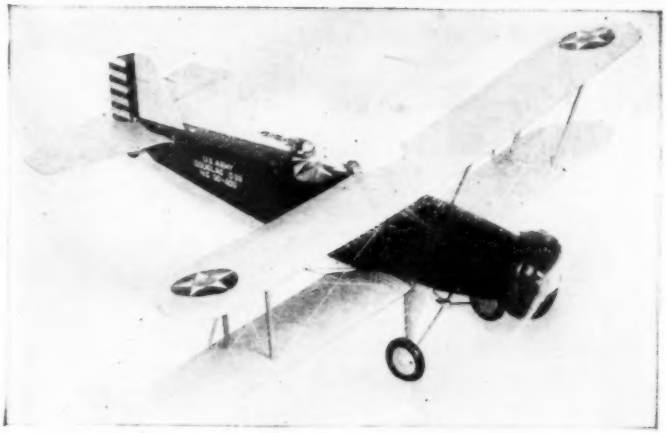

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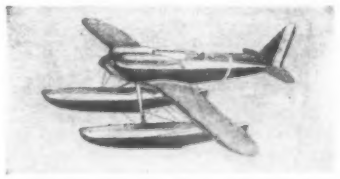

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See Page 47, Popular Aviation July issue, for further information of these "SuperDetail" Models.

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Katzmayr Effect

(Continued from page 98)

plane continued to be smooth and easy without calling for lateral control except on turns. The most noticeable feature was the vibrating action of the flexible trailing edge and it seemed that this action had more to do with the elimination of wing drag than the possible Katzmayr effect.

The flexing actions which take place in a flexible wing are schematically illustrated in Fig. 1. The wing in its normal unflexed position is indicated by the lines B-A-Ai-B_1, i being the inherent angle of attack at which the wing is set to the fuselage. The primary or fuselage supports are at B and B_1, while the intermittent or outboard supports are located at C and C_1.

Simple lateral deflection without helicoidal distortion will bring the wing to the position shown in heavy lines, the limit of lateral deflections at the secondary support being governed by the adjustment of the upper and lower sills of the slots in the secondary bridge member. Helicoidal deflection in a positive sense, entailing an increase in the angle of attack (wash-in) brings the points A and Ai to (a) and (aa) respectively, while helicoidal deflection in a negative sense brings the points A and Ai to (d) and (dd) respectively, the twisting of the wing always taking place about the elastic axis E.

The spontaneous wash-in or wash-out of the wing thus causes a corresponding modication of the angle of attack, this modification being a minimum at the secondary supports and maximum at the tip of the wing. A slight initial wash-out during normal flight is always present, even in undisturbed air, since the distribution and sectional conformation of the material in the wing structure has been so contrived as to bring the elastic center slightly forward of the center of effort, which in a wing section of this type is very nearly constant for any angle of incidence.

In Figure 2 a plane equipped with flexible wings is shown as flying through an undulating air current in the straight flight path maintained by its inertia. The crests of the wave are at M and N, while the trough is midway between them at P. It is quite likely that the smooth lines of the air wave as depicted are in reality disturbed by eddies and minor oscillations, but taken as a whole the air waves may well follow the lines indicated. At the crests N and M the momentary direction of the air currents is horizontal, the same condition prevailing at the trough P.

From N to P the air current flows upward, while from P to M the current is downward, the maximum positive and negative angles of the air current being about midway between trough and crests. The angular relation of consecutive sections of the undulating air stream to the wing is illustrated in Fig. 3.

Now since the wing by reason of its inherent flexibility is able to adjust itself to a certain extent to the air currents it encounters, the effect of the upward current is to twist the wing upward and to bring any section of it to the position shown in dotted lines in Fig. 4, while the effect of a downward current will be that shown in Fig. 5.

From this it is evident that in a wing capable of spontaneous helicoidal deformation proceeding through an undulating air current two rather conflicting conditions prevail. In the first place the wind current changes its direction in a certical sense, and in the second place the wing itself changes its angle of attack with reference to the horizontal, the last condition being the direct consequence of the first one.

It is obvious that if the wing is too limber, the yielding of the wing will tend to vitiate the Katzmayr effect; on the other hand, if the elastic properties of the spars have been calculated adequately, a yielding of the wing to pressure occasioned by an excessive angle of the air current will keep the angular relation between wing and air currents within bounds and will thus preserve the Katzmayr effect. Possibly a pronounced negative drag may be obtained thereby.

Under ordinary conditions however, it is rather doubtful whether the oscillations of the air currents ever exceed two or three degrees in a wave length of not under five times the length of the chord of the airplane wing; the resulting Katzmayr effect would then hardly be sufficient to im-

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prove the forward speed of the plane.

It has been shown by wind tunnel tests that a wing of the profile which was used on the flexible-wing plane above referred to, is not efficient when perfectly rigid; when in this condition it possesses a very pronounced drag which could hardly be appreciably counteracted by Katzmayr effect. The actual wing however, was made flexible and had a highly resilient flexible trailing edge, the result being that the performance of the plane was out of all proportion to that which the wind tunnel test would lead one to expect.

Therefore, although the Katzmayr effect may be accepted as a contributory factor, the real reason for the efficiency of the wing must be sought in the flexibility of the wing and the peculiar pushing action of the resiliently flexible trailing edge.

This latter feature has been noted and commented upon by several eminent investigators and has been repeatedly brought to the attention of an unbelieving generation, merely to be rejected as "interesting but absurd." We might point, for instance, to the marvelous performance of the "Christmas Bullet," the first flexible wing plane ever built, which was consigned to oblivion as being too radical an innovation to merit serious investigation.

We quote the following from Prof. J. Bell Pettigrew, an authority on natural flight, who presented the results of his investigations in a paper read before the Royal Society, London, as far back as 1872:

"It is a peculiarity of natural wings, and of artificial wings constructed on the principle of living wings, that when forcibly elevated or pressed downward, even in a strictly vertical direction, *they inevitably dart forward.*"

There could be no question of Katzmayr effect in this case, the undeniable forwardly impelling force being evidently entirely due to the peculiar action of the flexible flight feathers.

The first experiment on record dealing with this feature is that made by the Italian physicist Giovanni A. Borelli, as described in his interesting work "De Motu Animalium," published at Leyden in 1686, an English translation of which has since been made available. The object of his experiment was to demonstrate the pushing action of the flexible trailing edge of an airfoil.

To this end a pair of artificial airfoils or wings, provided with resiliently flexible rear portion, fashioned not unlike the flight feathers of a bird's wing, were mounted on a car as shown in Fig. 6, the car having a perforated central piece adapted to slide on a staff. When the rig was released and allowed to slide down by its own weight, it was found that, instead of rotating backwardly, as would be the case with rig d airfoils, they actually rotated forward as if impelled by some unseen force.

In this case again there could be no question of Katzmayr effect, since once the model were fairly rotating, the helix angle remained constant for the remainder of the vertical descent.

The Borelli experiment is simple and easy to duplicate; those who still doubt the efficacy of flexibility and resilience in a wing, whether natural or artificial, can convince themselves at practically no expense and with very little trouble.

To sum up the matter, there is every possibility of very greatly reducing the power requirements of the present rigid wing airplane by the introduction of flexible trailing edges or by similar changes in the wing structure.

END.

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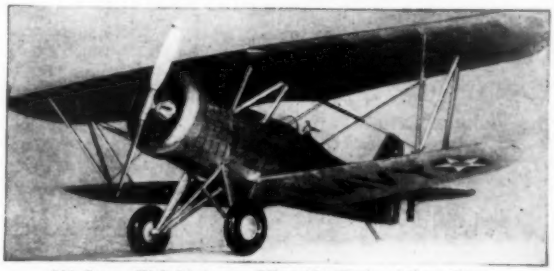
Curtiss Sea Hawk P3A



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New redesigned model with all parts printed on balsa. A finely detailed model, practically crashproof. Set includes 3" celluloid motor, aluminum motor plate and drag ring, balloon celluloid wheels, printed instrument board, fuselage, wing and rudder insignia, aluminum pilot's seat, drawing, semi-scale fibre prop, scale aluminum machine gun, dope, glue. Set in colored labeled gift box. **Set Complete, Postpaid**.....$2.50

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Driven by gas motor shown below. Special scale model const. set, includes all fuselage formers, ribs, etc., cut and notched to exact size. Turned wheels, silk covering, white dope, etc., easy to build. **Const. Set Complete**.....$25.00

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Bore	Stroke	Height	Weight	R.P.M.
⅞"	1"	5"	8 oz.	4000

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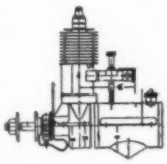
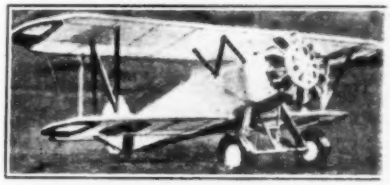


Boeing P12 Army Pursuit



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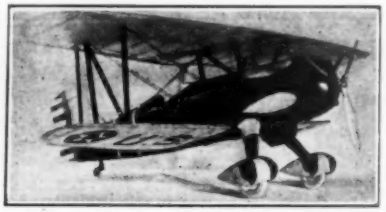

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CURTISS SWIFT

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Soundproofing

(*Continued from page 92*)

absorption. Thus a porous material like hairfelt presents little resistance to the entry of sound, but while its reflection is small, its absorbing powers are large because the acoustical energy is dissipated into heat in the small air channels.

Reflection and absorption do not complete the factors entering into the design of a panel. For a thin partition sound may be transmitted by setting the partition into vibration as a whole. The partition then acts as an independent source of sound waves, setting up compressions and rarefactions on the further side and giving a sort of fictitious transmission.

If the partition is rigid and massive, the vibrations are small and very little sound is transmitted by vibration; if thin and flexible then a considerable amount of energy may be transmitted in this manner. The requirements of a sound partition are then, for a given weight,

1. Maximum reflection.
2. Maximum absorption.
3. Rigidity of the panel as a whole.

The transmission-absorption of sound varies with the thickness of the absorbing material but not in direct proportion. For example if 1 inch of hairfelt stops 10 percent of the incident sound, 2 inches will stop 19 percent, and 3 inches 27 percent. We shall deal in a later article with the methods of measuring transmission and the properties of specific panels.

REFLECTION IN A PIPE

IN Fig. 8 a sound wave is traveling in the tube from left to right. If the wave passed unchanged from the small pipe to the large pipe, then by virtue of its larger area more energy would be transmitted into the large pipe than is coming from the small pipe. This would violate the principle of the conservation of energy.

What actually happens is that there is a reflected wave at the point P, so that less amplitude is transmitted into the larger conduit. At the junction then there is reflection of some of the sound energy and only a portion of the sound energy is transmitted again when sound passes from a large pipe to a small pipe.

AUDIBILITY

IN any medium the pressure varies periodically from a positive maximum to zero, then to negative maximum and so on. The mean or average pressure above the pressure of the medium at rest is thus zero. The intensity of the sound however varies with the mean square of the pressure. Thus, for pressures proportional to $+2$, and $+2.5$, the mean intensity would be proportional to

$$\frac{(2) + (2.5)^2}{2} = \frac{4 + 6.25}{2} = 5.125$$

Therefore, it is customary to refer to the pressure of a sound wave as the square root of this mean square. In this case the pressure would be indicated as $\sqrt{5.125} = 2.26$.

The pressure is generally measured in dynes per square centimeter (1 dyne per square centimeter is equivalent to .0145 pounds per square inch). A large number of experiments have been made on the value of minimum audible pressure or "Threshold" pressure as it is termed.

As the frequency increases, the threshold pressure diminishes although it is fairly constant above a frequency of 1000 vibrations per second. At the representative frequency of 512 per second, the pressure is approximately .001 dynes per square centimeter or .0000145 pounds per square inch. The chart of Fig. 9 indicates however that when the frequency passes beyond 4000, the threshold begins to rise rapidly.

Figure 9 also indicates that there is at any frequency a pressure which passes from noise to "feeling." At such a pressure the noise passes into intense discomfort.

From this chart, it is clear that not only the pressure of sound but its frequency is important from the point of view of airplane passenger comfort.

FREQUENCY AND ANNOYANCE

IN selecting sound proofing panels, as we shall see in a later article, some attention must be paid to appropriate selection of the panels to meet the effects of a predominating noise frequency. The airplane suffers from a whole range of sound frequency. It is probably more important on the whole to reduce the sound level, and the question of whether one type of noise or another is more distressing is rather a refinement.

Some people state that high frequency notes are more annoying to them than low notes. Others claim that prolonged exposure to low notes is specially troublesome. Experiments have been made on the loudness of notes of different pitches which were judged to be equally annoying to a number of observers trained in acoustical work.

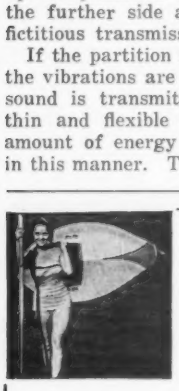
For notes below, say 500 cycles per second, the annoyance and loudness curves were parallel, that is to say the annoyance was determined by the loudness alone. Above this frequency there was a tendency for the high notes to be specially annoying.

The range of frequencies present in an airplane is very wide, and the frequency analysis is somewhat beyond the scope of this article. With a geared down propeller, 1024 r.p.m. two-bladed the frequency will be as low as

$$\frac{1024 \times 2}{60} = 34$$

vibrations per second. But propeller vibration will produce much more rapid frequency and the exhaust may give quite a shrill note.

The practical range is probably between 200 and 1000 cycles per second, with 512 as a fairly typical frequency. Fortunately, it is found that a panel which is best for sound proofing at one frequency is generally best at other frequencies. Therefore soundproofing may be primarily directed to reducing the noise level, with consideration of



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1/2 x 1/2...20 for 50c
1/32 x 2.....10 for 15c
1/16 x 2.....10 for 18c
3/32 x 2.....10 for 22c
1/8 x 2.....10 for 25c
3/16 x 2.....10 for 29c
1/4 x 2.....10 for 35c
1/2 x 2.....10 for 50c
1 x 2.....10 for 90c

PARA RUBBER
1/32 sq.....100 ft..... 8c
1/16 flat...100 ft.....12c
1/8 flat....100 ft.....20c
3/16 flat...100 ft.....30c
BRASS TUBING
1/8 Inside diam. 12 ft. 70c
BRASS ROD
1/16 Outside diam. 12 ft. 50c
ALUMINUM TUBING
1/16 O. D....12 ft. 40c
3/32 O. D....12 ft. 45c
1/8 O. D....12 ft. 50c
3/16 O. D....12 ft. 60c
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Japanese Silk — white and colored 12c p doz.

BAMBOO
1/16x1/4x11" 100 for 50c
1/16x1/4x15" 100 for 75c
WIRE
Straight—All sizes 10 ft. 3c
THRUST BEARINGS
Per dozen.....10c
WASHERS
Per dozen.....1c
CEMENT
In 6" tubes, p. doz. 95c
Per pint.....50c
DOPE
13 1 oz. bottles.....95c
Per pint.....50c
Colored Dope
12 1 oz. bottles.....95c
Per pint.....60c

BRUSHES 12 for 15c
CELLULOID WHEELS
3/8" diam....12 for 8c
1" diam....12 for 14c
1 3/8" diam....12 for 20c
1 1/2" diam....12 for 20c
1 7/8" diam....12 for 36c
2 1/4" diam....12 for $1
BALSA WHEELS
1/2" diam....12 for 6c
3/4" diam....12 for 8c
1" diam....12 for 10c
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frequency as a subsidiary refinement. An investigation of this topic is in progress at New York University.

LOUDNESS AND THE DECIBEL

THERE is general psychological law which states that change in sensation is proportional not to a change in intensity of the stimulus, but to the change in the intensity divided by the intensity itself. This law applies to hearing, vision and feeling.

Thus, if $S =$ sensation of loudness
$\rho =$ the pressure of sound

$$dS = \frac{K\, d\rho}{\rho}$$

and integrating $S = K \log_e \rho + a$
which may also be written

$$S = c \log_{10} \rho + a$$

In other words, the sensation of loudness is not proportional to the sound pressure but to the logarithm of the pressure. Now $\log_{10} 10 = 1$, and $\log_{10} 100 = 2$. Therefore multiplying the pressure by 10, only doubles the sensation of loudness. This is an idea of fundamental importance in the practical study of soundproofing.

Now if p_0 is the pressure corresponding to the threshold of audibility

$$So = o = c \log_{10} p_0 + a$$

and at any other pressure

$$S = c \log_{10} p + a.$$

So that

$$S = c\ (\log_{10} p - \log_{10} p_0) = c \log_{10} \frac{p}{p_0}$$

To define the sensation level, it is now customary to define it in terms of a new unit, the decibel and to write

$$S = 20 \log_{10} \frac{p}{p_0}$$

The sensation level is really the number of sensation units in decibel that are required to reduce the sound to the threshold limit.

The value of ? taken for the threshold pressure is .001 dynes per square centimeter which, as we have stated previously, is a representative value.

The magnitude of the decibel was so selected as to represent the smallest loudness change the car can detect.

If we write $S = 1 = 20 \log_{10} \frac{p}{p_0}$

then $\log_{10} \frac{p}{p_0} = 1/20 = .05$

and from a table of logarithms, we find that

$$\frac{p}{p_0} = 1.122$$

so that a change in sound level of 1 decibel represents 12.2% increase in pressure.

Now the energy of sound or its intensity varies with the square of the pressure. That this is so, should be clear from the following considerations: the energy is proportional to (pressure $\times$ displacement of particles) and the displacement is proportional to the pressure. Hence the energy is proportional

(*Concluded on page* 126)

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Soundproofing

(*Continued from page* 125)

to the square of the pressure. Hence if

$$\frac{p}{p_0} = 1.122,$$

the energy ratio is $(1.122)^2 = 1.26$. In other words a change in sound level of 1 decibel corresponds to a change in sound energy of 26%.

This ratio of 1.122 in pressures will hold at any sound pressure as can be shown by the following simple calculation.

Let pressure p_1 be .002 dynes/sq. cm.

Then $S_1 = 20 \log .002 + a$

If now the sound level is raised by one unit and the pressure is raised to p_2

$$S_2 = S_1 + 1 = 20 \log_{10} p_2 + a$$

and subtracting

$$1 = 20 \log_{10} p_2 - 20 \log_{10} .002 = 20 \log_{10} \frac{p_2}{.002}$$

so that $p_2/.002 = 1/20$ and $p_2/.002 = 1.112$ just as in the case previously discussed.

Since the intensity or energy of sound is proportional to p^2, it follows that $p \propto \sqrt{I}$ where I is the intensity, and the ratio

$$\frac{p}{p_0} = \sqrt{\frac{I}{I_0}}$$

Hence we can write

$$S = 20 \log_{10} \sqrt{\frac{I}{I_0}}$$

$$= 20 \log_{10} \left[\frac{I}{I_{10}}\right]^{\frac{1}{2}} = 10 \log_{10} \frac{I}{I_0}$$

a formula which is in some respects even more useful than the one relation the sound level to the pressure ratio.

Problem. The following problem may perhaps help to make our ideas more concrete:

Suppose that a source of sound such as an engine produces a sound intensity I_1 which gives a decibel level of 80.

Let us assume that a second engine doubles the intensity.

Let I_0 = the intensity at the threshold of audibility

$$\text{Then } S_1 = 10 \log_{10} \frac{I_1}{I_0} + a$$

$$\text{and } S_2 = 10 \log_{10} \frac{2 I_1}{I_0} + a$$

$$\text{and } S_2 - S_1 = 10 \log_{10} \frac{2 I_1}{I_0} - 10 \log_{10} \frac{I_1}{I_0} = 10 \log_{10} \frac{2 I_1}{I_1} =$$

$10 \log_{10} 2 = (10)\ (.3010) = 3.01$

Hence $S_2 = S_1 + 3.01 = 83.01$.

Doubling the intensity only increases the sound level by 3.01 decibels.

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Gen. Mitchell

(*Continued from page* 108)

degree of speed possible and at the same time thinking always of their comfort. Second, we must have very fast planes for mail, and for freight we must have an aerial express-run with the greatest economy possible."

Going back to the subject of airships, General Mitchell stated that he would advocate big airships—three times as big as the Akron, which will carry 24 planes each.

"A single raid from one of these airships equipped with planes, would determine the outcome of a war," he stated.

"I would not go as slowly as Commander Eckener in increasing the size of ships. His new ship is but little larger than the Macon."

Mitchell said that the reason he is so strong for airships is because the airship is the only means of air transportation which will go from any one spot on the earth's surface to another spot and back on one charge of fuel. It is also the only aircraft which can deliver a cargo in the air. And it is the only aircraft which can fly from the Pacific coast to Asia and back again, he stated. "Also it is the safest means of transporting people across the ocean in the temperate zone," he said.

"But we haven't any airship crews," he lamented. "We have but one man, —Rosendahl." He was vehement in his criticism of the navy policy of sending its airship commanders to sea duty and of putting untrained men in their places.

"There is no sense in turning the handling of this most complicated of our aircraft over to amateurs. It requires a special aptitude to handle airships and the crew must be fully trained," he declared.

He also stated that it didn't need to take so long to build airships. After the type is once decided upon, ships can be built very quickly. He pointed out, that during the war, Germany was able to hurry an airship through to completion in six weeks. He believes that it will only take three years to build up the dirigible program he has in mind.

As to the money end of his program, General Mitchell claims to have figured it so that all of this new set-up will not mean the expenditure of any more money. "And there will be no more messes or mix-ups," he concluded.

According to reports from Washington, General Mitchell will soon have a partner in the person of General Foulois, now head of the Air Corps and —like General Mitchell—in bad with the Senate. But the purpose and interests of the public will probably best be served by having these competent and earnest men out of the reach of politics where they can speak as they wish.

END.

The New Seversky

FROM the drawing of the Seversky L-3 all-metal plane, shown on the front cover, to the full page photograph on the rear cover, the September issue of POPULAR AVIATION is alive with interest.

New and useful articles on lightplane construction, a new American folding wing job will be described, the model section will contain more material than heretofore and the old departments that have proved so popular in the past will be enlarged. This issue, therefore will be of great value to all of our readers in all phases of aviation.

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POPULAR AVIATION
608 S. DEARBORN ST. CHICAGO, ILL.

T-2003

(*Continued from page* 84)

week. To make a long story short, in nine days I cleaned up $4,000 net. 'Twas a strain on the engine, though, and toward the last I never took off with more than 10 gallons of gas in the tank so it wouldn't be asking too much of the wheezy coffee-grinder to pull myself and passenger off the ground.

"Finally things got dead. It was time for me to hop back to Omaha, where I knew a mechanic versed in materia aeronautica, as you might say. I shipped my belongings there, filled the gas tank and, on the seat beside me, I piled my ill-gotten gains.

"Brother, you being from the effete East probably noticed that from Omaha on, the silver dollar prevails as a medium of currency. Well, that's what I'd been taking in that week, and over 3,000 of 'em were in six canvas bags alongside of me.

"Well, to make a long story short, she lost her grip and dropped into a nearby river and 3,000 silver dollars slid into the roily water. After some six hours a coupla natives were prospecting in the river bed and this gave me my big idea.

"I took what money I had in my pocket and leased the farms on either side of the crackup, and when an amateur prospector discovered one of the bags empty and busted, maybe the crowds didn't jam down to the river! But to start their prospecting they first had to pay me a dollar admission to my leased land.

"In two weeks I took in almost one thousand dollars, including the hot-dog stand concessions and I continued to 'salt' the waters with occasional dollars that I threw in.

"Then on one slack morning I paddled down the river where I saw something familiar on a sandbar strewn with snags. Know what it was? Well, it was a wing of the old pusher, and **safely strapped to the spar were four of the six money bags intact, each with their 500 dollars!"**

"Well, I got off smart enough (down hill), but with the full tank of gas and the money and me it was too much for the engine. Wheezing valiantly, but futilely, it couldn't keep the old pusher from settling down, down, down into the sandy waters of a nearby river.

"Oh, I got out safely, but again 3,000 silver dollars slid into the foily water.

"Inside of two hours, a coupla chiselers were prospecting in the river bottom for those silver dollars. It gave me an idea; I still had some money in bills in my hip pocket, and I leased the farmlands on either side of the scene of the last crack-up. An amateur prospector discovered one of the canvas money bags, busted and empty, and maybe the crowds didn't come down to the river again? That is, after they had paid *me* a dollar a head for coming through my land to do their prospecting.

"In two weeks I took in almost two thousand dollars, counting the hot dog and blind tiger concession. Prospecting waned, only ninety 'cartwheels' were dug up in that time, so I 'salted' some more silver dollars where they would be easily found. They were; and again the mining industry picked up. And so on for a month. My 'salting' expenses didn't amount to much; every yokel in the state thought he was a miner and paid for the privilege.

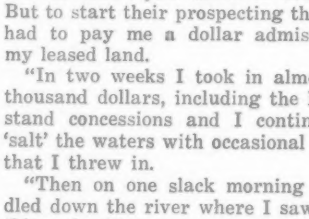
"It was just like playing the races. The customers remembered their winnings and overlooked their losses. The chances of any miner for coming out ahead of the game were very remote, to say the least. Once in a while, one would dig up three or four dollars in one day, but then he would go a week before he found another one.

"One morning, things being slack, I borrowed a canoe and paddled down the river a few miles. The water was low, and around a turn on a desolate sandbar strewn with snags I came upon something that looked familiar.

"It was what was left of a lower wing of the old pusher. I poked around it, and there, still safely strapped to a spar, were four of the six money bags, intact, each with their 500 silver dollars. I put them in the boat, rowed back and said nothing.

"Since that time I have foresworn flying. Even during the late war I was a 'kiwi,' or *ground* officer, in the Air Service. The business of concessions, amusements parks and the like have been more profitable, with far less risk to my person—or money. I started a specialty in amusement parks known as 'Mining.' Run some of the water aside from one of the 'Old Mills' and over an artificial sandbar. Chuck brass filings in the sand first, also some dimes. Costs two bits to rent a pan to go panning. The filings look like gold and the dimes are real. A great and profitable enterprise."

END.



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AIRPLANES

FOR SALE OR TRADE: Aeronca C-2. This ship has been completely rebuilt. New style drilled crankshaft, con. rods, pistons, rings, pins, valve lifters, cowling fuselage covering, new split gear, Goodrich air wheels. New $45 Hartzell. Trade for late car. Sell $400.—O. F. Milligan, 1609 First Avenue, Middletown, Ohio.

ATTENTION MODEL COLLECTORS! Will trade a beautiful Model V bottom speed boat, highly valued, for a three place open cockpit biplane. Must be licensed. Also have other model boats to swap if necessary. Description on request.—Edgar E. Pareis, 308 Lillion Ave., Union, N. Y.

WILL TRADE 3 place open biplane for a B flat bass clarinet, either Selmer or Buffet. Give age of instrument, and $100. I will give dual if wanted. If interested write and I will give complete details. — Douglas Livingston, 129 Spring Street, Portsmouth, N. H.

TRADE 1930 Heath Parasol V Type Flying struts, deep crank case motor, etc. Fly-away. Want a good 1930 Ford, Plymouth, Chev. or similar car.—John Kamm, 819 Fifteenth Street, Oshkosh, Wisconsin.

AIRCAMPER fuselage; wood constructed complete tail group, turtle back. Also parts for motor mount, landing gear. Will trade for anything of value.—Mondeck Bros., 1605 S. 48th Court, Cicero, Ill.

HEATH V, FLYAWAY. Want trade on light 2 seater. Or?—Frank Baumstark, Glen Ullin, North Dakota. No. 313.

LACK OF STORAGE SPACE forces sale. One Heath Parasol complete with new prop, wheels, tires, tubes and good engine. Must have either $75 cash or will swap for a boat of equal value. Will deliver 100 miles. I have mighty good value here.—William V. Dwarisky, 24A Glendale W, Somerville, Mass.

WILL TRADE government identified, 37 foot span monoplane type secondary glider for a cracked Travel Air, J6-150-R-540, with right upper and lower wings, landing gear, engine and fuselage intact. What have you?—Francis Ryan, 127 Parkwood Ave., Kenmore, N. Y.

PIETENPOL Air Camper with all parts for converting Ford engine. Will trade for a light car.—H. G. Harper, Carthage, Miss.

HEATH PARASOL, Pontoons for the Heath, Glider wings, Church Midwing. Will trade for an OX job. Crackups will be considered. We will also add some cash if the job warrants it.—Natick Aircraft Club, Natick-Wellesley Airport, Natick, Mass.

SUPER-HEATH PARASOL without engine. Wings and tail surfaces just recovered. I want a good motorcycle or what have you?—Stanley B. Morgan, R. F. D. 4, Eaton Rapids, Mich.

HEATH PARASOL nearly finished. Fuselage, tail surfaces finished with pigmented dope Stearman Vermilion. Wings need covering. Work by licensed mechanic. Trade for late model Harley Davidson. Or power driven shop tools.—Roman J. Nemmers, Dell Rapids, S. Dak.

WHAT am I offered in exchange for a good Model A Pietenpol? Flown 20 hours, new prop. Can use OXX6 motor with prop. OX5 prop, good radio or Model A car.—Russel Johnston, Box 56, Shepherdsville, Ky.

WANTED—Heath Parasol, A-1 condition. Must be cheap for cash or trade.—Z. Sajkowicz, 22 Howard St., Norwich, Conn.

HEATH PARASOL complete—25 hours. Motor A-1 condition. Cash or what have you?—E. J. Hill, 634 E. Stephenson St., Freeport, Ill.

JENNY new covering and new wheels. Will trade for car. Want used and wrecked motorcycles. What do you want?—Chester Mael, 206 W. Burns St., Portage, Wis.

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HAVE AMERICAN EAGLE crack up, less motor, will trade for light car, cash, or what have you.—J. C. Read, Leeds, N. Dak.

WILL SWAP Crawford Monoplane for good carpenter home work shop, ½ and 1 horse power electric motors 110 volt alternating current, or what have you?—Edwin Hageman, 37 N. Willow St., Montclair, N. J.

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TRADE WACO demonstrator glider. Excellent condition and ready to fly but recovering advised. Carefully stored in Ohio. State best offer including $35.00 cash. Want navigable light automobile, motorcycle, fishing tackle, or aeronautical textbooks; no stamps or thingumbobs. Consider reducing cash on good motor vehicle offer.—Box 542, Florence, S. C.

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WANTED—Motorwheel engine. Must be in running condition. Have Keystone hand operated movie projector to exchange. Will also add reasonable amount of cash.—Morris Levin, 1856 S. Avers Ave., Chicago, Ill.

WANTED—Small engine (complete). Have boxing gloves, baseball shoes and catchers mitt, etc. May add cash.—Wayne Meixner, 960½ E. Wash. St., Indianapolis, Ind.

DEAN BROTHERS steam engine and water pump. Capacity 35 gallons per minute. Will trade for what have you.—Penn H. O'Brien, Mooresville, Ind.

PROPELLERS, Harley, Indian, Henderson, New Zenith Altimeter, trade or sell.—Watson, 417 Broad St., Jackson, Florida.

HEATH-HENDERSON Engiue, prop and tachometer to exchange for a finished Harlequin crankshaft and crankcase or outboard motor of 5 horsepower or more.—F. M. Sears, Seneca, Nebr.

WANTED—Aircamper spars, landing gear and other parts, will exchange 1/4 and 1/6 H. P. 32 V.D.C. motors or cash.—Prentice Brothers, Park Rapids, Minn.

WANTED—Ford "A" aluminum high compression heads, four-cylinder magneto, and airwheels for Pietenpol. Dayton Aero Motor in any condition. What do you want?—C. A. Hughes, Jr., Elon College, N. C.

WANTED—Motorcycle, engine, portable typewriter, or airplane wheels. Have slide rule, portable phonograph, opera glasses, three foot stack of mechanical and science magazines.—R. Raspet, Bridgeville, Pa.

MISCELLANEOUS

YOUNG MAN will do parachute jumping and wing stunt in exchange for flying course.—L. E. Heitmeyer, 3124 Washington Blvd., Chicago, Ill.

WE HAVE 12 lesson wrestling course, a book of instructions for collecting butterflys and moths, also a large amount of model airplane kits, ready built models, magazine subscriptions, sell or trade. What am I offered? Any model built to order.—Bergstram's Miniature Aviation Co., Cuba, Kans.

YOUNG MAN of 19 willing to do anything honorable in exchange for board and flying instructions and further advancement. Give me a chance somebody. Can furnish references.—Donald Wolcott, Poultney, Vermont.

I AM 21 years old, am very much interested in aviation, have been trying to break into the game for a good many years, in fact too many. Have spent over $25 advertising for a job in leading aviation magazines and I am still right where I started years ago. So I am asking once again, will someone please give me a chance to get started in aviation? I will be only too happy to do anything from helping mechanics to parachute jumping, I don't care what it is, just so I can get a start in Aviation. Will be glad to work for just room and board only, and if that is unhandy for you, I will be glad to work for 4 or 5 dollars a week, and will go anywhere at anytime. Am 21, single, sober, clean, and a good hard reliable worker, a high school graduate. I have worked here in my dad's garage for over six years, so I am also mechanically inclined. Won't someone please help me get started in the hobby that has interested me for over ten years. Please write to W. B. Fisher, Jr., 1609 Center St., Des Moines, Iowa.

WILL TRADE $30 worth C-D kits, plans, and supplies for outboard motor, canoe or Mead 2-place Ki-Yak.—Edwin Lewis, 315 N. West St., St. Mary's, Ohio.

WANTED—Monoprep, for car and cash.—Address 109 Pine Street, Muscatine, Iowa.

WILL SWAP for cash or what have you Redicut model kits, plans, Oliver typewriter, No. 2 kodak, portable phonograph, Oddfellows lodge ring.—Albert Parker, Monroeville, Indiana.

WANT ONE-TUBE RADIO—parts. Have steel tennis racquet, chemicals, model airplanes.—Emsie W. Thompson, Jr., 92 N. Water St., Gallatin, Tenn.

TRADE excellent Conn cornet, case, extras; want good outboard motor between 8-15 h.p.—Clifford Jeffords, Seymour, Texas.

YOUNG MAN 22, university student, will work hard for flying lessons, board, small compensation. Will go anywhere.—Write H. Jorgensen, 927—6th Ave. S., Minneapolis, Minn.

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HEATH V, prints, motor mount, prop, oil gauge, etc. Want blowtorch, tools, short wave, type, motorcycle or?—Frank Baumstark, No. 313, Glen Ullin, N. Dak.

HAVE ENCYCLOPEDIA, formula for making soft drinks, water-pump, etc. Will trade for lightplane, accordion, tools or what have you?—Elmer R. Eyster, Thomasville, Pa.

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Engine Quiz

(*Continued from page 84*)

Q. What would happen if the heat were insufficient?

A. The carbureter would "freeze" or be so reduced in temperature that the gasoline would no longer evaporate.

Q. Where is the heat obtained?

A. From the engine. In some cases the carbureter is heated and the inlet manifold or pipe from the carbureter is generally warmed by the engine heat when not jacketed. The remainder of the vaporization takes place within the cylinder when the spray strikes the hot cylinder walls or during compression.

Q. Is this all there is to the carbureter?

A. No. The practicable carbureter is provided with many mixture compensating devices that make it quite complicated. It must adjust the mixture automatically for high and low speed, for changes in temperature and altitude and for different loads. This, however, will be taken up in more detail later in this series of articles.

Q. How is gasoline supplied to the carbureter?

A. By gravity flow from an elevated tank, by a power driven gasoline pump or by air pressure.

Q. Has gasoline been vaporized in any other device than by a carbureter?

A. Yes. There is the mixing valve, inlet manifold injection and direct injection into the cylinder somewhat after the manner of a Diesel engine.

Q. Describe a mixing valve.

A. This is simply a large light flat valve placed in the inlet line so that the suction of the pistons opens the valve and allows air to rush to the cylinders. Then, on the face of the valve seat is a very small hole connected with the gasoline supply. When the valve is opened by suction, the gasoline flows through the hole and mixes with the air. No float valve is necessary.

Q. Is the mixing valve as effective as the carbureter?

A. No. It is not so easy to adapt it to automatic control.

Q. Is the manifold injection system now used?

A. No, but it was employed on the first Wright engines, a gasoline nozzle being run into the intake manifold so that no carbureter was required.

Q. Describe the direct injection system.

A. The gasoline is sprayed into the cylinder by pump pressure at the end of the compression stroke. This permits higher compression pressures than with the mixtures, since only pure air is compressed.

IGNITION SYSTEMS

Q. How is the igniting spark produced?

A. By a high voltage electric current jumping through the mixture near the end of the compression stroke. The flow of the current heats the air to about 5,000°F. and thus starts the combustion.

Q. What is the length of this spark?

A. From 1/32 inch to 1/8 inch, depending upon conditions.

Q. Why isn't the spark longer?

A. The current flow and heating effect is greatest with a short spark.

Q. What voltage is generally required?

A. From 15,000 to 30,000 volts is generally applied, depending upon the compression.

Q. What has the compression to do with the voltage?

A. The higher the compression, the greater must be the voltage required to break down the resistance of the mixture. A voltage producing a spark ½-inch long in the open air, is reduced to about 1/8-inch at 80 pounds compression.

Q. What is the color of the spark?

A. The primary "breakdown spark" that breaks down the resistance of the mixture is a bright bluish-white. Surrounding this spark is a reddish flame produced by the succeeding flow of current.

Q. Does the spark ignite all of the mixture at once?

A. No. It lights a small patch in the vicinity of the plug and from this point, the flame spreads out along radial lines to the farthest part of the combustion chamber.

Q. Does the flame spread very rapidly?

A. With the engine running 2,000 revolutions per minute, combustion must be complete within about 1/700 of a second.

Q. How is the spark introduced into the cylinder?

A. By means of the "spark-plug." This consists of a threaded steel shell, screwed into the cylinder that carries a porcelain or mica insulating rod. One of the current carrying wires or "electrodes" is in the center of the insulator and it projects into the combustion space. Another electrode, carried by the steel shell, comes close to this center electrode but does not touch it. The space between the electrodes is the "spark gap."

Q. Where is this plug placed?

A. When one plug is used, it is best placed near the center of the cylinder head, but when two plugs are used, they are usually placed at diametrically opposite points in the cylinder. The plugs, when in this position, reduce a tendency toward detonations and insure quick ignition through the greater mass of the mixture.

END.

Airy Chat

(*Continued from page 72*)

ject of aerodynamics and aeronautical engineering. He is a professor at New York University and is in charge of the Guggenheim Foundation for Aeronautics. His article is authentic and useful to those of our readers who are regarding aviation development seriously.

* * *

STRANGE to say, Anthony Fokker has taken up the European distribution and sale of American airplanes. Himself a world renowned designer, has become a salesman. According to an interview related in *The Aeroplane*, Fokker believes that the further development of the airplane rests with the large corporations because of the great amount of money required for research work. He is quoted as saying that the experimental work on the Douglas plane amounted to approximately $350,000 and that no small concern could hope to compete in such research work.

* * *

ON the back cover of this issue, you will find a full page colored photograph instead of the colored drawings shown previously on the back covers of the June and July issues.

We will appreciate any comments on the colored photograph that you wish to make so as to guide us in the publication of future issues. We wish to know whether you prefer this colored photograph idea to the colored drawings or whether you prefer the full page black and white photograph that we used to run several months ago on the inside back cover. Now after seeing specimens of the three types, you will be able to give us a well-grounded answer.

* * *

THAT Nungesser article by Carl B. Ogilvie has raised a lot of comment, particularly in respect to the Hanriot brought to this country. But it is for Frank P. Heck, 5439 Brynhurst Ave., Los Angeles, Calif., to tell of a Hanriot pursuit plane of which he sends a photo. This is what he has to say.

I am sending you this message in the hope that it will be of interest to yourselves and to Mr. Carl Ogilvie. I am a newsstand reader of P.A., and in reading the article, "Nungesser—the Man of Iron," written by Mr. Ogilvie, I ran across something that immediately recalled a fact to my mind.

In this article, in the June issue, Mr. Ogilvie states that Charles Nungesser and two French pilots brought over to this country a Nieuport, Potez and a Hanriot. I believe he says that they were brought over in 1924. He further states that, to his knowledge, the Nieuport is the only one left in this country and that it is now in the Roosevelt Field Historical Museum.

To my sincerest knowledge, I think that I have visible evidence, as shown in the accompanying photograph of the Hanriot pursuit plane mentioned in this article. Further evidence may be had from the insignia on the side of the fuselage.

I am somewhat of a "photo fan" and happened to possess this particular picture in my collection. This plane may still be found in a hangar adjacent to the Douglas Aircraft Company, Santa Monica, Calif.

I snapped this photo the day that this ship was flown for exhibition over the race course during the 1933 National Air Races. I remember this ship six or eight years ago; completely torn down and stacked away in a corner. It is now reconditioned and is capable of being flown.

This is, indeed, very interesting and it would be a fine idea if some more of these old-timers were reconditioned and flown. There are a number of wartime ships that only need a little work to put them in the air for the enjoyment of the present generation.

* * *

WELL, here we are at the end again. I have a lot to talk about —but we'll let that go until next time.

J. B. R.

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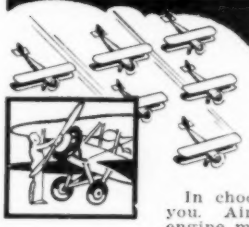

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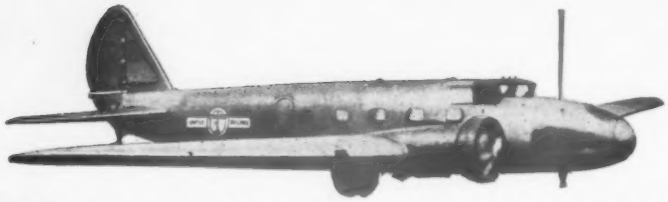

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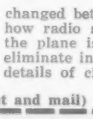

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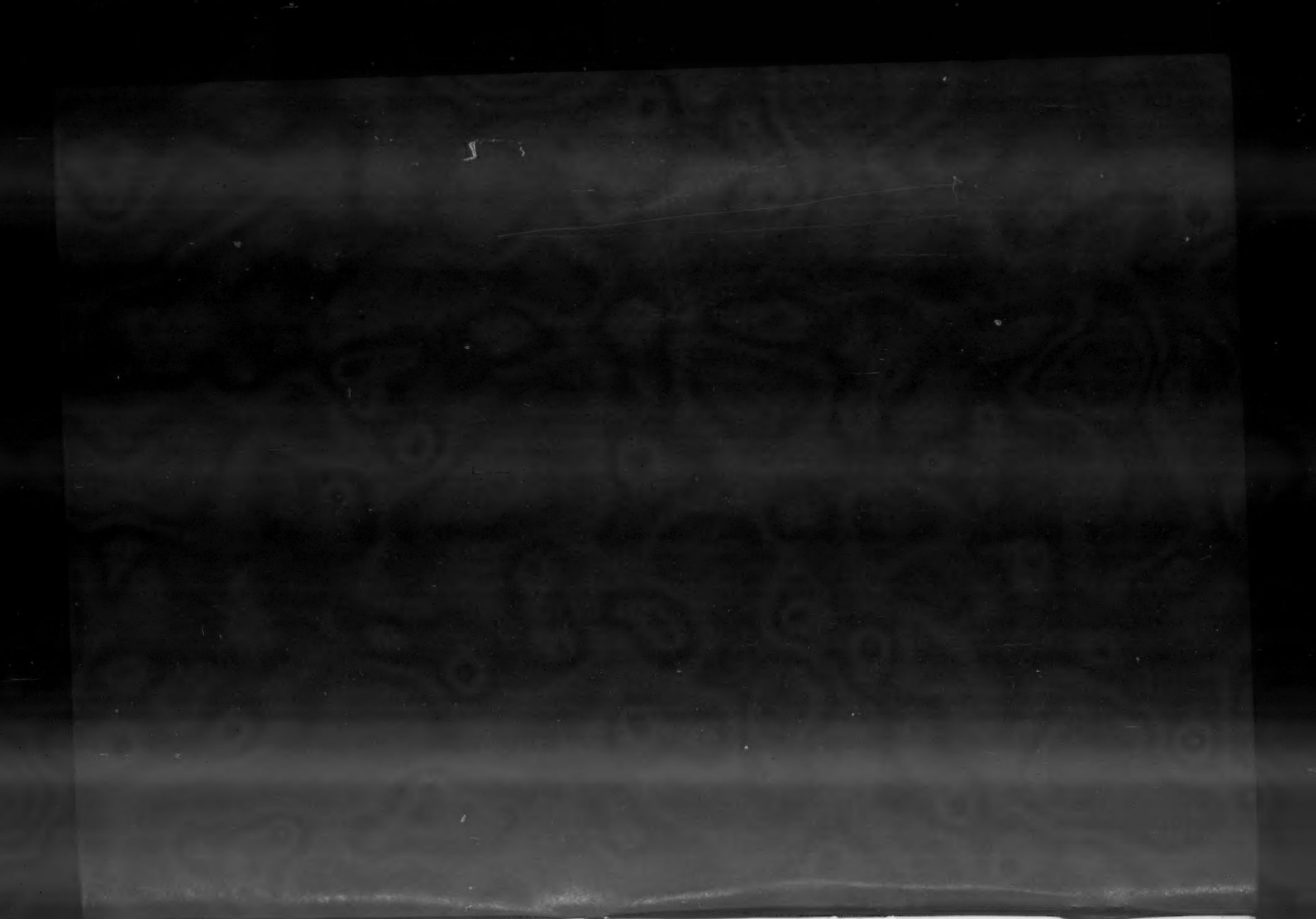

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